Steering Committee Discussion on Scientist to Scientist Meeting on Mining Waste Issues
Product/Activity Lists
What's Happened, What's Happening, and What Will Be Happening
4/21/00 Draft List

OUTLINE:

I. EPA Regional, OSWER and ORD Items (includes Butte Montana projects; excludes other ORD-NCERQA projects):
II. EPA's Office of Air and Radiation, Office of Radiation and Indoor Air (OAR.ORIA) Items:
III. EPA ORD-NCERQA Program and Solicitation Information (not including Butte Montana projects):
IV. Other Federal Agencies
V. Other References:
  A) Web Pages:
  B) Other Non-Federal Agency References

Topic Areas:

1) Characterization/monitoring
2) Remote Sensing
3) Fate/transport
4) Control of releases from mining sites
5) Risk assessment
6) Remediation and treatment
7) Environmental effects (i.e., physical/chemical effects to the environment)
8) Ecological (i.e., biological/ecosystem effects to the environment)
9) Technical Transfer (i.e., what information exchange is occurring)
10) Other Documents/Projects
11) Modeling and Predictive Tools

EPA Offices/Regions filling out this form: ORD/NRMRL-Cin; ORD/NRMRL-Ada; ORD-NCERQA; ORD/NERL; OAR/ORIA; Regions 8, 9, and 10

I. EPA Regional, OSWER and ORD Items (includes Butte Montana projects; excludes other ORD-NCERQA projects):

*To delete or add another row, do the following: a) shade one of the boxes by putting the curser in the left column box before the new row to be added, and pressing shift and right or left arrow simultaneously; b) click the right button on your mouse; c) click insert; d) click row.

Topic Area 1: Characterization/Monitoring

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
1) Characterization of Mine Leachates and the Development of a Ground-Water Monitoring Strategy	2/99	Larry Eccles, ORD/ NERL		EPA/600/R-99/007

2) Journal article, Assessing mine drainage water quality from mineralogic color and spectral reflectance, plus other internal reports, due over the next several years. The weathering of sulfide minerals associated with coal mining creates a variety of environmental problems including sedimentation and loss of in-stream biological integrity. Production of mine drainage is a local, regional and global level problem. The extensive nature of mine drainage requires prioritizing of remediation efforts. Remote sensing can be used to identify and map mine drainage impacted regions. Mine drainage water pH and dissolved sulfate concentrations can be estimated from the spectral reflectance of the resident mine drainage sediments. The minerals comprising the sediments occurring at each pH mode are spectrally separable. Spectral analysis techniques such as color indices and spectral angle difference mapping can be used to correlate sediment spectral reflectance with stream water pH and dissolved sulfate. This information can be used by scientists and managers to assess streams impacted by mining activities and monitor remediation efforts.		David James Williams	703-648-4798	
3) Empirical model for estimating TMDL loads associated with coal mining and acid deposition in the mid-Atlantic region	9/01	Dr. Terry Flum	513-569-7715	
4) Technical Support for Site-Specific Monitoring and Site Ongoing Characterization Requests (TSC) Examples of major reports done in 1999 for site-specific requests include “Groundwater Fate and Transport Modeling for Texarkana Wood Preserving Company Superfund Site, Texarkana, Texas”; Dispersion Modeling of Atmospheric Deposition Patterns around the Asarko Omaha Lead Refinery”; and “Air Dispersion Modeling of Mine Waste in the Southeast Missouri Old Lead Belt”. Examples of Issue Papers done through the TSC include “The Lognormal Distribution in Environmental Applications (1998), EPA/600/R-97/006; Field Sampling and Selecting On-site Analytical Methods for Explosives in Water (1999), EPA/600/S-99/002; and “Some Practical Aspects of Sample Size and Power Computations for Estimating the Mean of Positively Skewed Distributions in Environmental Applications” (2000)		Ken Brown	702-798-2270	http://es.epa.gov/ncerqa/ru/index.html
5) Long Term Dissolution Testing of Mine Waste				EPA530-R-95-040-A

6) Mining Sites in the National Priorities List; NPL Site Summary Reports (Complete Set)	June 1991			EPA530-SW -91-065
7) PROFILE OF THE METAL MINING INDUSTRY: SECTOR NOTEBOOK PROJECT				EPA310R95 008
8) PROFILE OF THE NON-FUEL, NON-METAL MINING INDUSTRY: SECTOR NOTEBOOK PROJECT				EPA310R95 011
9) PUBLICATIONS ON MINING WASTE MANAGEMENT IN INDIAN COUNTRY				EPA530-B-99-006
10) Report to Congress on Special Wastes from Mineral Processing: Summary and Findings	July 1990			EPA530-SW -90-070B
11) Report to Congress: Wastes from the Extraction and Beneficiation of Metallic Ores, Phosphate Rock, Asbestos, Overburden from Uranium Mining, and Oil Shale	December 1985			EPA530-SW -85-033
12) Strawman II: Recommendations for a Regulatory Program for Mining Wastes and Materials Under Subtitle D of the Resource Conservation and Recovery Act	May 1991			EPA530-SW -91-056
13) Summary of Comments on Mining Waste Report to Congress	05/09/1986			EPA530-SW-86-030
14) Technical Analysis and Evaluation of Mining Site Remediation Costs (not sure who wrote this)	available in early 1997			
15) N/A				
16) U.S. Fish and Wildlife Service 3 year monitoring program/study at New Almaden Mine (San Jose California); mercury contamination at issue		John Hillenbr and, Region 9		
17) EPA, Office of Solid Waste. 1994, Acid Generation Prediction in Mining. Draft.				
18) EPA, Office of Solid Waste 1978. Compilation and Evaluation of Leaching Methods.				EPA/600/2/7 8/095
19) MacDonald, M. S., G. C. Miller, and W. B. Lyons. 1994. Water Quality in Open Pit Precious Metal Mines. University of Nevada, Reno.	02/15/1994			EPA/530/R/9 5/011, PB95-19124 3.

Topic Area 2: Remote Sensing Issues

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
20) Imaging Spectroscopy of Fugitive Environmental Contaminants Current techniques for identifying, quantifying and mapping the extent of environmental contamination from a wide range of chemical releases, involve time-consuming and expensive *in situ* sampling techniques and laboratory analyses such as gas chromatography and mass spectrometry. This research will evaluate the use of airborne/spaceborne imaging spectroscopy (hyperspectral remote sensing) for locating and identifying fugitive environmental contaminants on the land surface and in a water column (including mining wastes and contaminants associated with hazardous waste sites) by identification of unique spectral signatures in the solar reflective portion of the electromagnetic spectrum. Anticipated Products: Journal article, *The potential of imaging spectroscopy to detect fugitive environmental contaminants through changes in vegetation reflectance*, plus internal project reports.	Anticipated Products due over the next several years.	Terry Slonecker, ORD/NERL, and David Williams, ORD/NERL	Terry: 703-648-4289, and David: 703-648-4798.	
21) Assessment of the Impact of Point Sources on the Environmental Conditions of the Mid-Atlantic (MAIA) Region The objectives of this project are to support research needs for evaluation of anthropogenic activities on aquatic ecosystems and integration of watershed studies at different scales, to conduct a landscape assessment to develop an empirical model that accounts for non-point and point source pollution to streams, to assess the relative risk of the point sources on the environmental condition of the Mid-Atlantic region and to develop a comprehensive and geo-referenced data base of potential pollution point sources with attribute information for the MAIA region. The data base (beginning with Envirofacts) and the methodology will provide the means for stakeholders to be self-reliant in assessments of their local areas and interests.		Bob Schonbrod, ORD/NERL	702-798-2229	

21.5) Journal article, Assessing mine drainage water quality from mineralogic color and spectral reflectance, plus other internal reports, due over the next several years. The weathering of sulfide minerals associated with coal mining creates a variety of environmental problems including sedimentation and loss of in-stream biological integrity. Production of mine drainage is a local, regional and global level problem. The extensive nature of mine drainage requires prioritizing of remediation efforts. Remote sensing can be used to identify and map mine drainage impacted regions. Mine drainage water pH and dissolved sulfate concentrations can be estimated from the spectral reflectance of the resident mine drainage sediments. The minerals comprising the sediments occurring at each pH mode are spectrally separable. Spectral analysis techniques such as color indices and spectral angle difference mapping can be used to correlate sediment spectral reflectance with stream water pH and dissolved sulfate. This information can be used by scientists and managers to assess streams impacted by mining activities and monitor remediation efforts.		David James Williams	703-648-4798	
22) Activity IV, Project 15: Remote Imaging Spectroscopy-Imaging Spectroscopy is becoming an important remote sensing tool for the exploration and analysis of natural resources and environmental hazards. With regards to the Butte-Silver Bow and Clark Fork Superfund Sites, it may prove to be an invaluable asset in the long term monitoring and assessment of remediation efforts.	Sept 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
22.5) Research and evaluation of various remote sensor platforms for the identification of mountaintop removal mining practices and potential environmental impacts. This research will evaluate various remote sensing platforms for uniquely identifying the MR/VF phenomenon as a primary landscape indicator.		Mary J. Lacerte (PI), LEB/EPIC; and Terry Slonecker (Co-PI), LEB/EPIC,	Mary J. Lacerte - 703-648-4137, lacerte.mary@epa.gov; and Terry Slonecker - 703-648-4289, slonecker.t@epa.gov	

Topic Area 3: Fate/Transport

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
23) MODELING FUGITIVE DUST IMPACTS FROM SURFACE COAL MINING OPERATIONS, PHASE 3: EVALUATING MODEL PERFORMANCE				EPA454R96 002
24) REVIEW OF SURFACE COAL MINING EMISSION FACTORS	8/99	Ron Wilhelm	202 564 9379	EPA454R95 007; and EPA402-R-99-004A&B
25) Bird, D. A. 1993. Geochemical modeling of mine pit water: An overview and application of computer codes. Masters thesis. University of Nevada, Reno. PB95-191250.				EPA/530/R/95/012

Topic Area 4: Control of Releases from Mining Sites

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
26) Activity III, Project 13: Hydrostatic Bulkhead with Sulfate-reducing Bacteria The technology addressed in this project is designed to reduce or eliminate acid drainage from underground mine workings.				http://www.epa.gov/ORD/NRMRL/std/mtb/annual99d.htm#III,13 also at http://es.epa.gov/ncerqa/ru/index.html.
27) Damage Cases and Environmental Releases from Mines and Mineral Processing Sites	04/15/1998			EPA 530-R-99-023
28) Design and Operation of Waste Rock Piles at Non-Coal Mines.	available in early 1997			

29) Innovative Methods of Managing Environmental Releases at Mine Sites	April 1994			EPA530-SW-91-093N and EPA 530-R-94-012
30) Technical Document: Acid Mine Drainage Prediction	December 1994			EPA530-R-94-036
31) Total Maximum Daily Load (TMDL) for mercury will be developed over the next few years for the Bay Delta, California.		John Hillenbrand, Region 9		
32) EPA Region 9 Humboldt River, Nevada Watershed REMAP project; will provide an extensive data base on water quality in the watershed.		John Hillenbrand, Region 9		
33) Nevada Division of Environmental Protection (NDEP) is developing Total Maximum Daily Loads (TMDLs) for phosphorus and total suspended solids for reaches of the Humboldt River, Nevada.		John Hillenbrand, Region 9		
34) CALFED Bay-Delta Program "Revised Phase II Report" implementation plan: establishes targets to reduce mercury in rivers and the estuary by source control at inactive and abandoned mine sites. Activities are to be targeted at Cache Creek and the Sacramento River and its tributaries.	12/18/98	John Hillenbrand, Region 9		
35) NPDES permits for several large active copper mines in the Salt and Middle Gila watersheds, Arizona		John Hillenbrand, Region 9		

Topic Area 5: Risk Assessment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
36) Applying Phase IV Land Disposal Restrictions to Newly Identified Mineral Processing Wastes	04/30/1998			EPA530-R-99-027
37) Human Health and Environmental Damages from Mining and Mineral Processing Wastes; Technical Background Document Supporting the Final Rule	04/15/1998			EPA530-R-99-037

38) Location of Mines and Factors Affecting Exposure	06/30/1986			EPA530-SW-86-023

Topic Area 6: Remediation and Treatment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
39) Activity III, Project 1: EPA asked MSE to develop a treatment facility at one of these sites to treat acidic metal-laden water. Due to the remote nature of these locations, this facility was required to operate for extended periods of time on water power alone, without operator assistance. Year round treatment of AMD coming from the adit of a remotely located metals mine with a chemical precipitation process.	June 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
40) Activity III, Project 2: Clay-based Grouting Demonstration Surface and groundwater inflow into underground mine workings becomes a significant environmental problem when water contacts sulfide ores, forming acid drainage. Clay-based grouting, the technology selected for this demonstration, has the ability to reduce or eliminate water inflow into mine workings by establishing an impervious clay curtain in the formation.	April 1997	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99a.htm#III, 2 also at http://es.epa.gov/ncerqa/ru/index.html.
41) Activity III, Project 3: Sulfate-reducing Bacteria Demonstration; Acid generation typically accompanies sulfide-related mining activities and is a widespread problem. Acid is produced chemically, through pyritic mineral oxidation, and biologically, through bacterial metabolism. This project focuses on a source-control technology that has the potential to significantly retard or prevent acid generation at affected mining sites. Biological sulfate reduction is being demonstrated at an abandoned hard-rock mine site where acid production is occurring with associated metal mobility. Bacteria and an organic substrate were added to the flooded, underground mine workings to create an in situ biological reactor.	January 2002	Diana Bless	(513) 569-7674 bless.diana@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm

42) Activity III Project 4 Comparison of three technologies for the removal of nitrate from mine water	April 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
43) Activity III, Project 5: Biocyanide Demonstration The main goal of this project was to use a strain of bacteria to destroy cyanide associated with precious metal mining operations. Another project goal was to develop a reactor design that will best use the cyanide-degrading effects of the bacteria to destroy cyanide from mining wastewater.	9/97	Roger Wilmoth, ORD/NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 5 also at http://es.epa.gov/ncerqa/ru/index.html.
44) Activity III, Project 6: Pollutant Magnet The small-scale pilot project demonstrated a two-step process for removing arsenic from contaminated mine water.		Roger Wilmoth, ORD/NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 7 also at http://es.epa.gov/ncerqa/ru/index.html.
45) Activity III, Project 8: Underground Mine Source Control By injecting a source control material, underground pathways (fractures) will be sealed, and an impervious groundwater barrier will be formed. Materials testing will be performed to determine which source control material will be selected. Demonstrates the feasibility of a grout material (Hydro Active Combi Grout) for reducing water influx and minimizing the production of acid mine drainage at a nonferrous metal mine		Roger Wilmoth, ORD/NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 8 also at http://es.epa.gov/ncerqa/ru/index.html.
46) Activity III, Project 9: Arsenic Removal The purpose of the Arsenic Removal Demonstration Project was to demonstrate three alternative treatment technologies capable of removing arsenic from mineral industry effluents to below 50 ppb.	12/98	Roger Wilmoth, ORD/NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 9 also at http://es.epa.gov/ncerqa/ru/index.html.

47) Activity III, Project 10 Surface Waste Piles Source Control demonstrates the feasibility of source control materials, i.e., innovative grouts, as surface waste pile stabilization materials. Stabilizing and/or encapsulating the surface waste pile in situ will provide hydrogeologic control by reducing water influx & minimizing the production of AMD at a nonferrous metal mine.	September 2000	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 9 also at http://es.epa.gov/ncerqa/ru/index.html
48) Activity III, Project 11: Cyanide Heap Biological Detoxification The basic process for bio-detoxification of cyanide heaps has already been identified, demonstrated, and proven to be commercially applicable and effective. However, numerous questions remain about the final efficiency, total capital and operating costs, applicability to multiple ore types, time required to completion, and the effects of the biological treatment on related discharge parameters such as pH, sulfates, nitrates, and entire suites of metals, including recoverable spike concentrations of gold. This project demonstrated the use of four biological process, water rinsing and peroxide rinsing as source control treatments for cyanide removal from a gold heap leach operation.	Feb. 2000	Pat Clark	513-569-7681Clark.Patrick@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
49) Activity III, Project 12: Sulfate-reducing Bacteria Reactive Wall By injecting source control materials strategically in the surface waste pile, there will be a decrease in waters infiltrating through the pile, thereby, decreasing the environmental impact caused by the pile. This technology will be applied in situ, meaning that the pile will be stabilized in place and not excavated and moved to another location for stabilization.	12/2000	Alva Daniel	(513) 569-7693 daniels.alva@epa.gov	http://www.epa.gov/ORD/NRMRL/std/mtb/annual99c.htm#III, 12 also at http://es.epa.gov/ncerqa/ru/index.html.
50) Activity III, Project 13 Hydrostatic Bulkhead with Sulfate-Reducing Bacteria will demonstrate a combination hydrostatic bulkhead constructed of concrete and rebar, with a colony of SRB placed behind the bulkhead. The acid drainage in the mine will be treated by raising the pH of the contained water behind the bulkhead causing metals to be removed. Metal removal processes that can occur include adsortion and complexion of metals by organic substrates, biological sulfate reduction, and filtration of suspended and colloidal materials. Biological sulfate reduction, however, should be the predominant metal removal mechanism.	Sept 2001	Ivars Licis		

51) Activity III, Project 14 Biological Barrier is Microbial capping technology involves the stimulation of beneficial bacteria at the surface of the tailings or waste-rock pile to remove oxygen from water infiltrating the waste, thereby reducing acidic drainage and stabilizing dissolved metal ions.	Sept 2000	Ivars Licis		www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
52) Activity III , Project 15 Engineered Tailings Cap demonstrates the ability of a engineered tailings cap that incorporates mine tailings, (remnant mining process material) with a source control material to stabilize the tailings pile. The use of an in situ capping technology would reduce wind and water erosion and would be cost effective in most cases.	Sept. 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
53) Activity III, Project 16 Integrated Passive Biological Treatment Process: This will demonstrate an integrated, passive biological technology to completely treat acid mine drainage emanating from a remote, abandoned, precious-metal mine. The technology will utilize both anaerobic (namely sulfate-reducing bacteria) and aerobic bacteria for complete removal of all metal contaminants.	January 2003	Diana Bless	(513) 569-7674 bless.diana@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
54) Activity III, Project 18: Gas-fed Sulfate-reducing Bacteria Berkeley Pit This project will demonstrate and evaluate a process with the potential to profitably recover copper, zinc, and sodium hydrosulfide from Berkeley Pit water.		Roger Wilmoth, ORD/NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99d.htm#III, 18 also at http://es.epa.gov/ncerqa/ru/index.html.
55) Activity III, Project 19 the SITE In Situ Mercury Technologies Demonstration Project will conduct comparative mercury stabilization tests using mercury-contaminated material from a waste rock pile. Mercury contamination often is a critical problem at mine sites, and there is a recognized need to identify technologies for mercury remediation. The application of an in situ mercury stabilization technology would provide an alternative treatment to complete removal of mercury-contaminated materials from remote abandoned mine sites.	Sept. 2000	Ed Bates		

56) Activity III, Project 20 – The Selenium Removal/Treatment Alternatives Demonstration Project will determine the effectiveness of various selenium removal processes, including the Best Demonstrated Available Technology, an innovative physical/chemical process, a biological process, and an enzymatic process. The project is being conducted at an operating mineral industry site in Utah.	January 2001	Alva Daniels	(513)569-7693 daniels.alva@epa.gov	
57) Activity III, Project 21 - Integrated Process for Treatment of B-Pit Water applies systems engineering techniques to (1) optimize costs for acid rock drainage treatment, and (2) attempt to improve overall economics by selective product recovery from the water.	Nov. 2000	Diana Bless	(513) 569-7674 bless.diana@epa.gov	www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm
58) Activity II, Project 22- Phosphate Stabilization of Heavy Metals-contaminated Mine Waste Yard Soils - Joplin, Missouri NPL Site will demonstrate that phosphoric acid/potassium chloride treatment of residential soils contaminated by mine waste will reduce lead bioavailability in children and other human receptors. The phosphate treatment should also decrease the environmental mobility (e.g., lowered plant uptake of lead, cadmium and zinc from soil solution).	Dec. 2000	Alva Daniels	(513) 569-7693 daniels.alva@epa.gov	None to date
59) Activity III, Project 23 Revegetation of Mining Waste Using Organic Soil Amendments and Evaluate the Potential for Creating Attractive Nuisances for Wildlife Demonstration Project will develop technical information on using organic soil amendments to improve soil conditions, reduce erosion, enhance plant establishment, and stabilize metals. In addition, the impact of the selected soil amendments on the uptake of metals from mine waste to vegetation will be evaluated which could create an attractive nuisances that would present food chain risk for foraging wildlife. This demonstration will involve establishing vegetation on the selected plots on mine tailings in Missouri. These plots will be evaluated for three growing seasons.	Nov 2002	Ivars Licis		
59.1) Activity III, Project 24 - Improvements in Engineered Bioremediation of Acid Mine Drainage The objective is to demonstrate improvements of bioremediation on acid mine drainage through 1)selection of a better media with organic carbon 2) design of permeability and contact time enhancing system 3) design of an organic carbon replaceable cartridge system 4) development of computer software to simulate SRB bioremedial process in the bioreactor	November 2004	Diana Bless	(513) 569-7674	

60) Activity IV, Project 1: Berkeley Pit Water Treatment- Bench-scale research on treatment of water from the Berkeley Pit was performed. The overall goal was to evaluate technologies that produce clean water, allow for safe waste disposal, and recover selected metals for resale. Technologies were evaluated by considering their effectiveness, technical feasibility, and potential for technology transfer to similar sites. Experimental testing consists of four major phases: physical oxidation, neutralization, and metal removal; metals separation and recovery; use of milling waste: and diversion and treatment of various inflow water sources.	June 1996	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
61) Activity IV, Project 2: Sludge Stabilization The purpose of this research project was to study the properties and stability of sludges generated by remediation of acid mine waters. Results of the study were used to determine the best methods for sludge handling and disposal.		Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99e.htm#IV, 2 also at http://es.epa.gov/ncerqa/ru/index.html.
62) Activity IV, Project 3: Photoassisted Electron Transfer Reactions Research– this research attempted to identify and enhance naturally occurring processes that would help remediate toxic anions while minimizing treatment by-products. In this regard, the use of dissolved and solid photocatalysts was investigated for the removal of cyanide and nitrate anions from mine waste waters.	April 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	http://www.epa.gov/ORD/NRMRL/std/mtb/annual99e.htm#IV, 3 also at http://es.epa.gov/ncerqa/ru/index.html.
63) Activity IV, Project 3A: Photoassisted Electron Transfer Reactions for Metal-Complexed Cyanide–This research assessed the effects of direct photolysis and homogeneous photolysis for destruction of cyanide and cyanide metal complexes.	July 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
64) Activity IV, Project 3B: Photoassisted Electron Transfer Reactions for Berkeley Pit Water-This research examined processes to remediate anions, particularly sulfur as sulfate, arsenic as arsenite and arsenate, nitrate, cyanide and metal-complexed cyanides.	October 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	

65) Activity IV, Project 4: Metal Ion Removal From Acid Mine Waste Water by Neutral Chelating Polymers-A bench-scale research project was performed to test a novel technology based on neutral chelating polymers that can have their chelating property turned on and off. The chelate switch was based on known electrochemical or photochemical properties of electrically conducting polymers.	April 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
66) Activity IV, Project 5: Removal of Arsenic As Storable Stable Precipitates-The objective of this project was to strip arsenic from solutions in such a way as to produce apatite mineral-like precipitated products that are stable for long-term storage in tailing pond environments.	May 1997	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
67) Activity IV, Project 7: Berkeley Pit Innovative Technologies Project -The purpose of the Berkeley Pit Innovative Technologies Project was to provide a test bed for high risk/innovative technologies for the remediation of Berkeley Pit water. The project focused on bench-scale testing of remediation technologies to help assist in defining alternative remediation strategies for the EPA's future cleanup objectives for Berkeley Pit waters.	January 1999	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
68) Activity IV, Project 8: Pit Lake System-Characterization and Remediation for the Berkeley Pit several aspects of the Berkeley Pit Lake system were studied to better understand the system as a whole, which may lead to new or improved remediation technologies to be used during future cleanup. The following research is being conducted on the Berkeley Pit Lake: Biological Survey of Berkeley Pit Water; Sediment/Pore Water Characterization; Sulfate Reducing Bacteria; Surface Oxidation Reactions; Organic Carbon; and Sedimentation Rates.	11/99	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99fg.htm#IV, 8 also at http://es.epa.gov/ncerqa/ru/index.html.
69) Activity IV, Project 9: Pit Lake System-Deep Water Sediment/Pore Water Characterization and Interactions This project involves collecting samples and data to identify the sediment/pore water resident conditions, solution phase speciation, and solid phase chemical, physical, and mineralogical characteristics that presently exist within the upper layer and deeper layers of the sediment/pore water deep-water deposits of the Berkeley Pit.	11/99	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99g.htm#IV, 9 also at http://es.epa.gov/ncerqa/ru/index.html.

70) Activity IV, Project 10: Pit Lake System-biological Survey of Berkeley Pit Water The primary goals of this study was to determine species diversity and numbers for organisms present in these mine waste areas and to determine their potential ecological role in the system for bioremediation.	11/99	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99g.htm#IV, 10 also at http://es.epa.gov/ncerqa/ru/index.html.
71) Activity IV, Project 11: Pit Lake System-Characterization and Remediation for the Berkeley Pit, Phase II- This research will focus on the following topics; organic carbon in Berkeley Pit sediments; wall rock/water interactions; bioremediation of the Berkeley Pit Lake System; effects of tailings deposition into the Berkeley Pit	March 2000			
72) Activity IV, Project 12: An Investigation to Develop a Technology for Removing Thallium from Mine Waste Waters--This research will be conducted in response to the need for bench scale laboratory investigations to develop appropriate thallium removal technologies. Two technologies that may be able to meet the proposed thallium level are proposed for laboratory bench-scale experimental study, e.g., manganese dioxide adsorption and reductive cementation of thallium utilizing elemental iron.	January 2001	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
73) Activity IV, Project 14: Artificial Neural Networks as an Analysis Tool for Geochemical Data-This research applies to artificial neural network (ANN) analysis to geochemical and similar data sets; such as those acquired from the Berkeley Pit, Butte, MT.	February 2000			
74) Activity IV, Project 15: Remote Imaging Spectroscopy-Imaging Spectroscopy is becoming an important remote sensing tool for the exploration and analysis of natural resources and environmental hazards. With regards to the Butte-Silver Bow and Clark Fork Superfund Sites, it may prove to be an invaluable asset in the long term monitoring and assessment of remediation efforts.	Sept 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
75) Activity III, Project 7: Arsenic Oxidation The Arsenic Oxidation Project was proposed to demonstrate and evaluate arsenic oxidation and removal technologies. It demonstrated the use of an innovative technology which oxidized arsenite to arsenate in drinking and smelter process water to make the arsenic easier to remove by the BDAT process.	6/97	Roger Wilmoth, ORD/ NRMRL		http://www.epa.gov/ORD/NRMRL/std/mtb/annual99b.htm#III, 7 also at http://es.epa.gov/ncerqa/ru/index.html.

78) Technical Report: Design and Evaluation of Tailings Dams, August 1994. EPA530-R-94-038. Order Number: PB94-201 845		Roger Wilmoth , ORD/ NRMRL		
79) Technical Report: Treatment of Cyanide Heap Leaches and Tailings	September 1994	Roger Wilmoth , ORD/ NRMRL		EPA530-R-94-037 (http://www.epa.gov/epaoswer/other/mining.htm)
80) Sacramento Sanitation District one million dollar study to develop a Sacramento River Toxic Pollutant Control Program that has mercury as one of its principle concerns		John Hillenbrand, Region 9		
81) Mercury stabilization- ORD/NRMRL is working with Region 9,the SITE program, and vendors to develop/test methods for in-situ stabilization of Hg in mining waste		Ed Bates, ORD/NRMRL		
82) Acid Mine Drainage treatment- ORD/NRMRL is working with Region 8, state of Colorado, and the SITE program to test a “SAPP” system, a lime lagoon system, and zeolites at the Summitville site	summer 2000	Ed Bates, ORD/NRMRL		
83) Natural Attenuation- ORD/NRMRL is working with Region 8 to evaluate apparent natural attenuation of some metals in near neutral discharges as such discharges flow through alluvium on the French Creek site.		Ed Bates, ORD/NRMRL		
84) In-situ remediation of contaminants in groundwater and soils The purpose of the research is to expand upon current laboratory techniques for the assessments of creating a reactive zone by manipulating redox conditions in-situ for the purpose of ground water and soil remediation of hexavalent chromium and selected chlorinated hydrocarbons. These innovative techniques will be demonstrated in a small field scale study. The results of the small scale field study will contribute to the development of remedial design for the full scale implementation and may have application for other reducible metals.		Robert Puls, ORD/NRMRL,	Phone580-436-8543, puls.robert@epa.gov	

85) Enhanced transformation and detoxification of chlorinated solvents and arsenic in groundwater and soils by zero-valent metals The goal of this study is to investigate organic (chlorinated hydrocarbons) and inorganic (arsenic) contaminant remediation in systems containing natural aquifer materials and simulated groundwater using chemical reactive materials, which are potentially suitable for incorporation into reactive and permeable barrier walls. The specific processes governing the transformation of both types of contaminants will be elucidated. In particular, the mechanisms of adsorption-desorption, oxidation-reduction, and precipitation of arsenic species will be the focus of this project. A specific objective of this project will be to examine a series of metallic materials and their modifications that are economically and chemically suitable for developing in situ remediation technologies.		Robert Puls, ORD/NRMRL,	Phone580-436-8543, puls.robert@epa.gov	
86) Water/rock interactions, Sulphur Banks Hg Mine		Dave Jewett, ORD/NRMRL,	Phone580-436-8560, jewett.david@epa.gov	

87) An in situ permeable reactive barrier for the treatment of hexavalent chromium and trichloroethylene in ground water A permeable *in situ* subsurface reactive barrier composed of 100% granular zero-valent iron (ZVI) was installed in June, 1996, at the U.S. Coast Guard Support center near Elizabeth City, North Carolina to treat overlapping plumes of chromate and (Cr(VI)) and chlorinated solvent compounds (trichloroethylene (TCE), cis-dichloroethylene (c-DCE), and vinyl chloride (VC)). Concentrations in excess of 10 mg/L Cr and 19 mg/L TCE had been detected in the ground water at the site since 1991. The wall was emplaced using a continuous trenching machine. The PRB is 46 m long, 7.3 m deep and 0.6 m wide and oriented perpendicular to ground water flow. This project was initiated in 1992 and completed in 1999. There is over 4 years of post installation performance monitoring of the system and continued long-term performance is being assessed as part of the next project listed below. Chromium is removed from the ground water to less than detection limits (<0.01 mg/L) and considerably less than regulatory target levels (0.1 mg/L). This is accomplished via redox reactions accompanied by precipitation processes due to the corrosion of the iron. Likewise there is reduction in CVOC concentrations to less than regulatory limits where these compounds are entering and being treated by the iron wall.		Robert Puls, ORD/NRMRL,	Phone580-436-8543, puls.robert@epa.gov	
88) PRB strategies and performance monitoring for remediation of inorganic contaminants Permeable Reactive Barriers are an emerging in-situ technology for remediating ground water contamination. To date most experimental and field investigations have implemented zero-valent iron as the reactive barrier material, although other organic and inorganic media are actively being explored as alternative barrier components. Although PRB strategies are increasingly being developed for treatment of inorganic contaminants, incompletely understood are the mechanisms of transformation processes and long-term potential of PRB technologies for the remedy of inorganic contaminants. The principal goals of this research project address the remediation mechanisms and long-term performance of zero-valent Fe mixtures for treating arsenic and chromium contaminant plumes, and extending PRB use for ameliorating acidic, metal-rich solutions typical of acid mine drainage.		Rick Wilkin, ORD/NRMRL,	Phone: 580-436-8874, wilkin.rick@epa.gov	

89) Natural attenuation of inorganics during metal sulfide formation Metal fixation during iron sulfide formation is a key environmental process that governs the distribution and mobility of metal contaminants in sediments and soils. Iron sulfide minerals are especially common components of soil/sedimentary environments, and reactions at the surfaces of iron sulfides play pivotal roles in metal retention, mobility, and bioavailability. Although essential for predicting the fate of metals in specific environmental realms, incompletely understood are the details of reaction mechanisms, geochemical cycling pathways, and the limiting factors that govern metal uptake by iron sulfides. This research involves experimental studies that explore mechanisms and limitations of metal uptake during iron sulfide nucleation and growth.		Rick Wilkin, ORD/NRMRL,	Phone: 580-436-8874, wilkin.rick@epa.gov	
90) Natural Attenuation of Arsenic in an Urban Industrialized Watershed The potential natural attenuation of contaminant metals within a watershed is controlled by processes that sequester the metal from solution to immobile soil or sediment solids. Observation of arsenic cycling in natural systems suggests that partitioning to iron (hydr)oxide minerals may immobilize arsenic within soils and sediments. The proposed research explores the extent of this attenuation process within an industrialized watershed impacted by arsenic contamination from historical industrial activities. The study combines field and laboratory studies designed to 1) determine the geochemical processes that control aqueous and solid phase arsenic speciation and 2) evaluate the most reliable methods and practices for sample collection, preservation, and characterization. The results of this research will aid in the overall development of assessment criteria and practices for determining the potential for attenuation of arsenic via partitioning to soil and sediment matrices.		Robert Ford, ORD/NRMRL,	Phone: 580-436-8872, ford.robert@epa.gov	

91) Natural Attenuation by Iron (Hydr)oxides in soils and sediments The attenuation or stabilization of arsenic in soils and sediments is often controlled by partitioning reactions to mineral oxides. Iron (hydr)oxide minerals play a major role in arsenic cycling in these environments due to scavenging reactions that occur during Fe precipitation from ground and surface waters. Initially precipitated iron (hydr)oxides are rarely the most stable form, and transformation to more crystalline (or stable) products occurs with time. As a consequence of this transformation, coprecipitated arsenic could potentially be immobilized within crystalline Fe (hydr)oxides. The purpose of this study is to provide baseline rate data on the long-term stabilization of arsenic associated with Fe (hydroxides) under controlled laboratory conditions. This data will aid assessment of the attenuation/stabilization potential for arsenic in soils/sediments with a significant iron (hydr)oxide mineral component.		Robert Ford, ORD/NRMRL,	Phone: 580-436-8872, ford.robert@epa.gov	

Topic Area 7: Environmental Effects (i.e., physical/chemical effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
92) Background for NEPA Reviewers: Non-Coal Mining Operations.				EPA530-R-95-043
93) Geochemical Modeling of Mine Pit Water: An Overview and Application of Computer Codes				EPA530-R-95-012) 12/15/1994
94) HISTORIC HARDROCK MINING: WEST'S TOXIC LEGACY, THE CRITICAL LINK BETWEEN WATER QUALITY AND ABANDONED MINE SITES				EPA908F95002
95) Region 9 Carson River, Nevada Superfund Site Study is looking at historical impacts of mercury contaminated mine tailings in Lahonton reservoir and the wetland areas below the Lahonton dam.			John Hillenbrand, Region 9	

96) Forest Service, BLM, USGS, Fish and Wildlife Service, the California SWRCB, DTSC, Dept. of Conservation, Dept. of Park and Recreation, Fish and Game, and the Nevada County Resource Conservation District have a collaborative $600,000 effort underway to study mercury in Nevada’s Yuba River/Bear River watershed.			John Hillenbrand, Region 9	
97) BLM/EPA 1998. Draft Environmental Impact Statement: The Proposed Yarnell Mining Project. Phoenix, Ariz.: U.S. Department of the Interior, BLM. San Francisco, Calif.: EPA, Region IX.				

Topic Area 8: Ecological (i.e., biological/ecosystem effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
98) Identification of factors influencing biotic response to acid mine /drainage and acid deposition in MAHA	12/99	Dr. Terry Flum	513-569-7715	
99) Biodegradation of PHC-Contaminated Soil and Sludge at a Mining Facility				EPA/600/R-92/044
100) $3.7 million dollar study of mercury bioaccumulation in a central California watershed		Central Valley Calif. RWQCB; John Hillenbrand, Region 9		

101) USGS study concluded the highest levels of mercury contamination in biota in the Bear River-South Fork Yuba River, California, watersheds was near the largest volume of contaminated mine tailings.		John Hillen brand, Regio n 9		
102) EPA, Office of Water Regulations and Standards, 1985. The Gold Book: Quality Criteria for Water.				EPA/ 4401 5/86/ 001.
103) EPA, Office of Water. 1996. 1995 Updates: Water Quality Criteria Documents for the Protection of Aquatic Life in Ambient Water.				EPA/ 820/ B/96/ 001.
104) Activity I, Volume 1 – Issues Identification and Technology Prioritization Report Mobile Toxic Constituents – Water and Acid Generation	Oct. 199 3	Roger Wilmo th	(513) 569- 7509 wilm oth.ro ger@ .epa. gov	
105) Activity I, Volume 2 – Issues Identification and Technology Prioritization Report – Mobile Toxic Constituents – Air	May 199 3	Roger Wilmo th	(513) 569- 7509 wilm oth.ro ger@ .epa. gov	
106) Activity I, Volume 3 – Issues Identification and Technology Prioritization Report – Cyanide	July 199 3	Roger Wilmo th	(513) 569- 7509 wilm oth.ro ger@ .epa. gov	
107) Activity I, Volume 4 – Issues Identification and Technology Prioritization Report – Nitrate	Feb. 199 4	Roger Wilmo th	(513) 569- 7509 wilm oth.ro ger@ .epa. gov	

108) Activity I, Volume 5 – Issues Identification and Technology Prioritization Report – Arsenic	Aug. 1994	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
109) Activity I, Volume 6 – Issues Identification and Technology Prioritization Report– Pyrite	Dec. 1995	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
110) Activity I, Volume 7 – Issues Identification and Technology Prioritization Report – Selenium	Jan, 1998	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
111) Activity I, Report – Thallium Volume 8 – Issues Identification and Technology Prioritization	Feb. 1999	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
112) Activity I, Volume 9 – Issues Identification and Technology Prioritization Report – Pit Lakes	April, 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	

113) McCormick, F.H., B.H. Hill, L.P. Parrish, and W.T. Willingham. 1994. Mining impacts on fish assemblages in the Eagle and Arkansas Rivers, Colorado. Fish were collected at 18 sites in the Arkansas (N=6) and Eagle (N=12) rivers. Richness at all sites was low (1-3) species. Analyses of fish assemblage data from the Arkansas and Eagle rivers and their tributaries suggested significant differences among sites subject to mine impacts and control or recovering sites. Native taxa were collected at only one site in the Arkansas River drainage (*Onchrhynchus clarki clarki*) and only at the Eagle River control sites (Piaute sculpins, *Cottus beldingi*).	1994	Dr. Frank McCormick	513-569-7097	Journal of Freshwater Ecology 9: 175-179.
114) McFarland, B.H. and B.H. Hill. 1997. Abnormal *Fragilaria* spp. found in streams impacted by mine drainage. Periphytic diatom samples from a metal-contaminated Rocky Mountain river in Colorado, U.S.A. were analyzed on two occasions for the presence of morphological abnormalites. Samples were collected from natural (rocks) and artificial (tiles) substrates at 12 sites displaying a range of metal concentrations. Members of the genus *Fragilaria* sensu Krammer and Lange-Bertalot (including *Synedra* and *Hannaea*), which was abundant at all of the sampling sites, exhibited the highest incidence of abnormalities. There were no significant differences in percentage of deformed cells between natural and artificial substrates. Percentage of diatom abnormalities at each site ranged from 0.2 $\pm$ 0.2% to 12.0 $\pm$ 2.0% of the total population, and normal *Fragilaria* valves were always observed along with abnormal valves for each taxa. Percentage of abnormal valves at a site was transformed (arc sine square root) and regressed against dissolved cadmium, copper, iron, and zinc. For 1991, the best regression model fit (based on Mallows' C_p) was a two variable model using Cd and Zn (r^2=0.39, C_p=2.4). In 1992, the four variables model (Cd, Cu, Fe, and Zn) provided the best fit to the *Fragilaria* data (r^2=0.60, C_p=5.0). These data indicate that morphologically abnormal *Fragilaria* valves may be an indicator of elevated dissolved metal concentrations in streams.	1997	Dr. Brian Hill	513-569-7077	Journal of Freshwater Ecology 12: 141-149.

115) Hill, B.H., J.M. Lazorchak, F.H. McCormick, and W.T. Willingham. 1997. The effects of elevated metals on benthic community metabolism in a Rocky Mountain stream. The effects of elevated metals (dissolved ZN, MN and/orFe) in a Rocky Mountain stream were assessed using measures of primary productivity, community respiration, and water-column toxicity. Primary productivity was measured as rates of O_2 evolution from natural substrates incubated in closed chambers. Oxygen depletion within these chambers, when incubated in the dark, provided estimates or periphyton community respiration. Sediment community respiration on fine-grained sediments, collected and composited along each stream study reach, was measured on-site by incubating these sediments in closed chambers and measuring O_2 depletion. Toxicity was measured as percent mortality of *Ceriodaphnia dubia* during 48h acute tests. Gross (GPP) and net primary productivity (NPP) decreased significantly with increasing metal concentrations, from 10.88 ± 1.46 g O_2 m^{-2} d^{-1} to 0.83 ± 0.20 g O_2 m^{-2} d^{-1} and 9.85 ± 1.43 g O_2 m^{-2} d^{-1} to 0.81 ± 0.20 g O_2 m^{-2} d^{-1}, respectively for the reference and most impacted site. Community respiration (CR) declined from 0.65 ± 0.08 g O_2 m^{-2} d^{-1} to 0.02 ± 0.01 g O_2 m^{-2} d^{-1} with increasing metal concentrations. Sediment community respiration (SCR) decreased from 0.26 ± 0.02 g O_2 m^{-2} d^{-1} to 0.01 ± 0.01 g O_2 m^{-2} d^{-1} at these same sites. *Ceriodaphnia dubia* mortality increased from 0% at the reference site to 95 ± 5% at the most impacted sites. Net daily metabolism, quantum yield, and assimilation ratio all decreased with increasing metal concentrations suggesting that both autotrophic and heterotrophic components of the periphyton community were impaired. Overall, functional measures were able to discern sites receiving greater metal impacts from less-impacted sites, with combinations of dissolved metals explaining between 25 and 92% of the variance in the regression models. Using these regression models we were able to calculate lethal and inhibition concentrations of dissolved Zn in the Eagle River. The lethal concentration (LC_{50}) of Zn for *Ceriodaphnia dubia* is 123 mg/L**.** The concentrations of Zn which inhibited respiration (IC_{50}) were 177 mg/L for CR and 199 mg/L for SCR. These results indicate functional measures may be as sensitive to metal concentrations as acute toxicity tests mg/L for SCR. These results indicate functional measures may be as sensitive to metal concentrations as acute toxicity tests.	1997	Dr. Brian Hill	513-569-7077	Environmental Pollution 96: 183-190.

116) A.T. Herlihy, J.M. Lazorchak, F.V. McCormick, D.J. Klemm, M.E. Smith, W.T. Willingham, and L.P. Parrish: "Quantifying the Regional Effects of Mine Drainage on Stream Ecological Condition in the Colorado Rockies from Probability Survey Data - Results of the EPA Region 8 REMAP Project." The Southern Rockies Ecoregion contains almost 95% of the mineralized portion of the Rocky mountains. For the past century, strategic mining of metals has occurred in this area. Runoff from both active and inactive mining sites have contaminated waters and sediments. In 1993 and 1994, the U.S. EPA conducted a probability survey as part of its Regional Environmental Monitoring and Assessment Program (REMAP) in the Colorado portion of the Southern Rockies. The survey targeted second-fourth order streams as represented on digitized 1:100,000 scale maps. Over the two summers of the study, samples were successfully collected from 73 probability sites and 13 hand-picked reference (good) and test (bad) sites for indicators of fish and macroinvertebrate assemblages, physical habitat, and sediment and water chemistry and toxicity. The sample design allows inference to the status of 6,630 km of stream length in the Colorado Rockies from the sample data. Using stream chemistry, sites were classified into Least Disturbed, Mixed Impacts, and Mine Drainage Impacted Chemical Classes. The study area had roughly equal stream lengths in each of the three classes. Overall, an estimated 1,844 km (28%) of stream length had a sulfate signature of mine drainage, 438 km (7%) exceeded state Zn criteria and 376 km (6%) had water toxic to the test organisms. Sites with elevated metals and toxicity were concentrated in the mine drainage chemical class. Water column toxicity tests (48 hour fathead minnow and *Ceriodaphnia* survival) were better indicators of mine drainage stress than sediment toxicity test (7 day *Hyalella azteca* survival). Also, stream macroinvertebrate assemblages were more sensitive to mine drainage stressors than fish assemblages. The synoptic survey data gathered in the REMAP project provides a useful framework and baseline for assessing the extent of mine drainage impacts in the Colorado Rockies.	4/1998	Dr. Jim Lazorchak	513 569 7076	EMAP Symposium
117) Clements, William, H., Carlisle, D.M., Lazorchak, J.M. and Johnson, P.C., 1999. "The Role of Heavy Metals in Structuring Benthic Macroinvertebrate Communities in Colorado's Mountain Streams."	1999	Dr. Will Clements		Eco. Appl.
118) Conduct toxicity tests on Mine waste samples from 3-5 technologies. Each technology will have two samples, an influent and a treated sample (6 to 10 samples). Dilutions of samples may be necessary. Tests will be acute *Ceriodaphnia* fathead minnow, 4-day *Daphnia* growth and when possible 7-day trout growth.	1999-2000	Dr. Jim Lazorchak	513 569 7076	1999 Reports
119) Conduct toxicity test for superfund testing of water and/or sediment. Provide appropriate QA/QC for all superfund activities.. Testing use standard EPA acute and/or chronic methods as well as develop and or modify test methods for assessing mine waste treatment success. Two projects are anticipated, Clear Creek, Colorado in October 1999, and Summitville, Colorado, in October 1999 and in summer of 2000.	2000	Dr. Jim Lazorchak	513 569 7076	in progress

120) Hill, B.H., W.T. Willingham, L.P. Parrish, and B.H. McFarland. 2000. Periphyton community responses to elevated metal concentrations in a Rocky Mountain stream. The effects of elevated metals on stream periphyton in the Eagle River, a mining impacted river in central Colorado, were assessed in 1991 and 1992 using assemblage information (taxa richness, community similarity) and non-taxonomic measures (biomass, chlorophyll *a*, autotrophic index). The number of periphyton genera collected ranged from 2 at a site adjacent to abandoned mining operations to 21 at a downstream site, but was not significantly correlated with dissolved metals concentrations. *Fragilaria* and *Achnanthes* were the dominant genera at all sites, with *Fragilaria* dominating the less impacted sites and *Achnanthes* dominating at the more impacted sites. Taxonomic similarity was greatest among those sites receiving the greatest inputs of metals from mining operations, where the coefficient of similarity ranged from 0.87 to 0.99. Cluster analyses revealed significant differences among sites adjacent to the mine and either the upstream or downstream sites. Chlorophyll *a* content of periphyton and the autotrophic index in both years showed significant downstream decreases associated with increasing dissolved metals concentrations. Overall, the periphyton community data were able to separate metal contaminated sites from reference or less impacted sites, and responded in predictable ways to increasing metal concentrations of Eagle River water.	2000	Dr. Brian Hill	513-569-7077	Hydrobiologia (In press).
121) Activity I, Volume 9 – Issues Identification and Technology Prioritization Report – Pit Lakes	April, 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
122) The objectives of this project are to support research needs for evaluation of anthropogenic activities on aquatic ecosystems and integration of watershed studies at different scales, to conduct a landscape assessment to develop an empirical model that accounts for non-point and point source pollution to streams, to assess the relative risk of the point sources on the environmental condition of the Mid-Atlantic region (MAIA), and to develop a comprehensive and geo-referenced data base of potential pollution point sources with attribute information for the MAIA region. The data base (beginning with Envirofacts) and the methodology will provide the means for stakeholders to be self-reliant in assessments of their local areas and interests.		Bob Schonbrod, ORD/NERL	702-798-2229	

122.1) Genetic Induction and Genetic Diversity in Fish. Specifically, "Metallothionein Gene Transcription as an Indicator of Metal Exposure in Fathead Minnows." Metallothionein is cystine rich, low molecular weight, metal binding protein. Basal levels of endogenous metallothioneins (MT) have been reported in all eukaryotes. MT has been shown to play an essential role in regulating physiological requirements of essential metals such as zinc and copper, and elimination of non-essential metals such as cadmium and lead from the system via detoxification. Endogenous MT levels have been shown to be inducible by heavy metals. Our objectives are to investigate the Metallothionein gene (*Mt*) expression in aquatic organisms and use the onset of *Mt* gene transcription as an indicator for metal exposure/toxicity. To achieve our objectives, we have designed *Mt*-specific oligonucleotides based on the published gene sequence for common carp (*Cyprinus carpio*). Induction of *Mt* gene expression was measured in newly hatched fathead minnow larvae **(***Pimephales promelas*) exposed to varied concentrations of zinc sulfate. Fathead minnow larvae were exposed for 48-hrs to zinc concentrations between 25 and 250 ug/L. Following exposure, total RNA was isolated from larvae and *Mt* gene transcription was analyzed by RT-PCR. Results suggest that fathead minnows express constitutive levels of *Mt* messenger RNA ; however, the gene was inducible, with zinc, in a dose dependent manner. The lowest concentration at which *Mt* was induced (25 - 50 ug/L zinc) was less than that which produced effects measured in standard U.S. EPA 7-day fathead minnow short-term chronic survival (LC50 >240 ug/L) and growth (IC25 >90 ug/L) tests . *Mt* gene transcription was induced at concentrations far below those that result in the onset of sublethal toxicity. The results suggest that *Mt* gene expression is a very sensitive indicator for heavy metal exposures.		Reddy, T.V., Lattier, D.L., Lazorchak, J. M., U.S. EPA, Cincinnati, OH, Smith, M.E., SBI c/o U.S. EPA, Cincinnati, OH, and Toth, G.P., USEPA, Cincinnati, OH		
122.2) Development and evaluation of an indicator of the condition and vulnerability of aquatic ecosystems based on the level of genetic homogeneity within populations of wide-ranging species. Genetic data will be compared to physical, chemical, and habitat measures collected under EMAP to determine linkages and will add to the EMAP data set. This initiative will extend ongoing assessments of genetic diversity within the Eastern Cornbelt Plains Ecoregion and in the Mid Atlantic Integrated Assessment (MAIA) project area.		Dr Mark Bagley, ORD/NRMRL	513 569 7455	

122.3) Effects of metals on sites encompassing thousands of acres (e.g., 14,000 acres at Anaconda site under remediation) and hundreds of miles (Clark Fork River is 126 miles and Whitewood Creek in SD has potentially impacted up to 240 river miles), particularly if sites are located in non-populated areas surrounded by areas rich in diverse fisheries and wildlife		Dale Hoff, Ph.D. Region 8 Ecotoxicologist BTAG Coordinator & John Hillen-brand, Region 9		

Topic Area 9: Technical Transfer (i.e., what information exchange is occurring)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
123) Draft EPA Region 8, 9 and 10 Mining Strategy Documents (these discuss mining-related issues, contacts, activities, and strategies in the region)		Mike Bishop (8), John Hillenbrand (9) and Nick Ceto (10)		

124) Region 10 Mining Profile; Consists of: a) fact sheets for the major proposed, operating and inactive mining facilities in each state. Staff supplemented this with general information on mining that describes trends in the industry for each state. updated annually.; b) a Region 10 Mining "who's who" directory of people from various state and federal agencies involved with managing mining activities. Includes an internal 'directory' of EPA staff currently working as part of discrete teams on mining projects in Region 10; and c) a listing of each state's authorities and capabilities to deal with current and future mining issues, and a compendium of selected state regulations that identify State authorities and the nature of their specific mining programs.		Nick Ceto (10)		
125) Activity V, CD-ROM Project- In an effort to make the work done by the MWTP more accessible the MWTP in the process of producing a set of CD's designed for audiences ranging from grade schools to industry professionals. The first CD, the Annual Report CD, is a summary of the entire program, designed for the general public. It includes movies, pictures, and a general description of the projects being undertaken by the MWTP. The second CD, the Activities in Depth CD, provide the details of each project as well as electronic versions of all final reports and presentations. This CD is designed for industry professionals looking for project specific data and results.	April 2000	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	
126) Activity VI, Training and Education Activities-The Training and Education component of the MWTP consists of three distinct educational initiatives: conference and short course preparation and delivery; Mine Waste Emphasis Graduate Program and the minority initiative.	May, 2002	Roger Wilmoth	(513) 569-7509 wilmoth.roger@.epa.gov	

Topic Area 10: Other Documents/Projects

Question: Any thoughts on whether you'd find it useful to listing out all projects in the region, coupled with the regulatory status of each?

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
127) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 1: Lead-Zinc	June 1994			EPA530-R-94-011 (http://www.epa.gov/epaoswer/other/mining.htm)

128) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 2: Gold	July 1994			EPA530-R-94-013 (http://www.epa.gov/epaoswer/other/mining.htm)
129) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 3: Iron	August 1994			EPA530-R-94-030 (http://www.epa.gov/epaoswer/other/mining.htm)
130) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 4: Copper	August 1994			EPA530-R-94-031 (http://www.epa.gov/epaoswer/other/mining.htm)
131) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 5: Uranium	December 1994			EPA530-R-94-032 (http://www.epa.gov/epaoswer/other/mining.htm)
132) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 6: Gold Placers	October 1994			EPA530-R-94-035 (http://www.epa.gov/epaoswer/other/mining.htm)
133) Technical Resource Document: Extraction and Beneficiation of Ores and Minerals; Volume 7: Phosphate and Molybdenum	November 1994			EPA530-R-94-034 (http://www.epa.gov/epaoswer/other/mining.htm)
134) TECHNICAL SUPPORT DOCUMENT: INTERNATIONAL TRAINING WORKSHOP, PRINCIPLES OF ENVIRONMENTAL ENFORCEMENT: MINING: METALLIC ORES AND MINERALS				EPA300R95008
135) ALASKA PLACER MINING METALS STUDY, YEAR 2				EPA910R99004
136) Determination of Water Balance at Mine Sites.	available in early 1997			

137) Guide to Designing Environmental Audits at Mining Operations.	available in early 1997			
138) Identification and Description of Mineral Processing Sectors and Waste Streams; Technical Background Document; Final	04/15/1998			EPA530-R-99-022
139) Inactive and Abandoned Noncoal Mines (Complete Set)	08/15/1991			EPA530-R-92-005
140) Introduction to Hard Rock Mining: A CD-ROM Application	09/15/1997			EPA530-C-97-005 Order Form: OSW
141) Land Applications Disposal of Spent Cyanide Solution.	available in early 1997			
142) Subaqueous Disposal of Mine Tailings.	available in early 1997			
143) Technical Studies Supporting the Mining Waste Regulatory Determination				EPA530-SW-86-026) 06/30/1986
144) USEPA Workshop report - mine waste technical forum	7/25-27/95			trying to get a copy electronically
145) USEPA Mine Waste Policy Dialogue Committee, Meeting Summaries and Supporting Material	March 1994			EPA 530-R-94-043
146) USEPA's national hardrock mining framework EPA. 1997. Office of Solid Waste and Emergency Response; Office of Enforcement and Compliance Assurance; Office of Water.				http://www.epa.gov/owm/permits/hrmining/frame.htm
147) USING THE CLEAN WATER STATE REVOLVING FUND FOR WATERSHEDS IMPAIRED BY MINING				EPA832F99052
148) EPA. 1997a. EPA Office of Inspector General Audit Report--1997: EPA Could Do More To Help Minimize Hardrock Mining Liabilities.				E1DMF6-08-0016-7100223.

Topic Area 11: Modeling and Predictive Tools

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office / Lab	**phone/ email**	**Publication number/ web address**
149) Empirical model for estimating TMDL loads associated with coal mining and acid deposition in the mid-Atlantic region	9/01	Dr. Terry Flum	513-569-7715	
150) Journal article, Assessing mine drainage water quality from mineralogic color and spectral reflectance, plus other internal reports, due over the next several years. The weathering of sulfide minerals associated with coal mining creates a variety of environmental problems including sedimentation and loss of in-stream biological integrity. Production of mine drainage is a local, regional and global level problem. The extensive nature of mine drainage requires prioritizing of remediation efforts. Remote sensing can be used to identify and map mine drainage impacted regions. Mine drainage water pH and dissolved sulfate concentrations can be estimated from the spectral reflectance of the resident mine drainage sediments. The minerals comprising the sediments occurring at each pH mode are spectrally separable. Spectral analysis techniques such as color indices and spectral angle difference mapping can be used to correlate sediment spectral reflectance with stream water pH and dissolved sulfate. This information can be used by scientists and managers to assess streams impacted by mining activities and monitor remediation efforts.		David James Williams	703-648-4798	
151) Technical Support for Site-Specific Monitoring and Site Ongoing Characterization Requests (TSC) Examples of major reports done in 1999 for site-specific requests include “Groundwater Fate and Transport Modeling for Texarkana Wood Preserving Company Superfund Site, Texarkana, Texas”; Dispersion Modeling of Atmospheric Deposition Patterns around the Asarko Omaha Lead Refinery”; and “Air Dispersion Modeling of Mine Waste in the Southeast Missouri Old Lead Belt”. Examples of Issue Papers done through the TSC include “The Lognormal Distribution in Environmental Applications (1998), EPA/600/R-97/006; Field Sampling and Selecting On-site Analytical Methods for Explosives in Water (1999), EPA/600/S-99/002; and “Some Practical Aspects of Sample Size and Power Computations for Estimating the Mean of Positively Skewed Distributions in Environmental Applications” (2000)		Ken Brown	702-798-2270	http://es.epa.gov/ncerqa/ru/index.html

<u>152) Assessment of the Impact of Point Sources on the Environmental Conditions of the Mid-Atlantic (MAIA) Region</u> The objectives of this project are to support research needs for evaluation of anthropogenic activities on aquatic ecosystems and integration of watershed studies at different scales, to conduct a landscape assessment to develop an empirical model that accounts for non-point and point source pollution to streams, to assess the relative risk of the point sources on the environmental condition of the Mid-Atlantic region and to develop a comprehensive and geo-referenced data base of potential pollution point sources with attribute information for the MAIA region. The data base (beginning with Envirofacts) and the methodology will provide the means for stakeholders to be self-reliant in assessments of their local areas and interests.		Bob Schon brod, ORD/ NERL	702-798-2229	
153) MODELING FUGITIVE DUST IMPACTS FROM SURFACE COAL MINING OPERATIONS, PHASE 3: EVALUATING MODEL PERFORMANCE				EPA454R 96002
154) Bird, D. A. 1993. Geochemical modeling of mine pit water: An overview and application of computer codes. Masters thesis. University of Nevada, Reno. PB95-191250.				EPA/530/ R/95/012
155) Geochemical Modeling of Mine Pit Water: An Overview and Application of Computer Codes				EPA530-R-95-012) 12/15/1994

156) Hill, B.H., J.M. Lazorchak, F.H. McCormick, and W.T. Willingham. 1997. The effects of elevated metals on benthic community metabolism in a Rocky Mountain stream. The effects of elevated metals (dissolved ZN, MN and/orFe) in a Rocky Mountain stream were assessed using measures of primary productivity, community respiration, and water-column toxicity. Primary productivity was measured as rates of O_2 evolution from natural substrates incubated in closed chambers. Oxygen depletion within these chambers, when incubated in the dark, provided estimates or periphyton community respiration. Sediment community respiration on fine-grained sediments, collected and composited along each stream study reach, was measured on-site by incubating these sediments in closed chambers and measuring O_2 depletion. Toxicity was measured as percent mortality of *Ceriodaphnia dubia* during 48h acute tests. Gross (GPP) and net primary productivity (NPP) decreased significantly with increasing metal concentrations, from 10.88 ± 1.46 g O_2 m^{-2} d^{-1} to 0.83 ± 0.20 g O_2 m^{-2} d^{-1} and 9.85 ± 1.43 g O_2 m^{-2} d^{-1} to 0.81 ± 0.20 g O_2 m^{-2} d^{-1}, respectively for the reference and most impacted site. Community respiration (CR) declined from 0.65 ± 0.08 g O_2 m^{-2} d^{-1} to 0.02 ± 0.01 g O_2 m^{-2} d^{-1} with increasing metal concentrations. Sediment community respiration (SCR) decreased from 0.26 ± 0.02 g O_2 m^{-2} d^{-1} to 0.01 ± 0.01 g O_2 m^{-2} d^{-1} at these same sites. *Ceriodaphnia dubia* mortality increased from 0% at the reference site to 95 ± 5% at the most impacted sites. Net daily metabolism, quantum yield, and assimilation ratio all decreased with increasing metal concentrations suggesting that both autotrophic and heterotrophic components of the periphyton community were impaired. Overall, functional measures were able to discern sites receiving greater metal impacts from less-impacted sites, with combinations of dissolved metals explaining between 25 and 92% of the variance in the regression models. Using these regression models we were able to calculate lethal and inhibition concentrations of dissolved Zn in the Eagle River. The lethal concentration (LC_{50}) of Zn for *Ceriodaphnia dubia* is 123 mg/L**.** The concentrations of Zn which inhibited respiration (IC_{50}) were 177 mg/L for CR and 199 mg/L for SCR. These results indicate functional measures may be as sensitive to metal concentrations as acute toxicity tests mg/L for SCR. These results indicate functional measures may be as sensitive to metal concentrations as acute toxicity tests.	1997	Dr. Brian Hill	513-569-7077	Environmental Pollution 96: 183-190.
157) The objectives of this project are to support research needs for evaluation of anthropogenic activities on aquatic ecosystems and integration of watershed studies at different scales, to conduct a landscape assessment to develop an empirical model that accounts for non-point and point source pollution to streams, to assess the relative risk of the point sources on the environmental condition of the Mid-Atlantic region (MAIA), and to develop a comprehensive and geo-referenced data base of potential pollution point sources with attribute information for the MAIA region. The data base (beginning with Envirofacts) and the methodology will provide the means for stakeholders to be self-reliant in assessments of their local areas and interests.		Bob Schonbrod, ORD/NERL	702-798-2229	

158) EPA, Office of Solid Waste. 1994, Acid Generation Prediction in Mining. Draft.				
159) Technical Document: Acid Mine Drainage Prediction	Dece mber 1994			EPA530-R-94-036
160) Strawman II: Recommendations for a Regulatory Program for Mining Wastes and Materials Under Subtitle D of the Resource Conservation and Recovery Act	May 1991			EPA530-SW-91-05 6
161) Summary of Comments on Mining Waste Report to Congress	05/09 /1986			EPA530-SW-86-030
162) Technical Analysis and Evaluation of Mining Site Remediation Costs (not sure who wrote this)	avail able in early 1997			
163) Water Quality in Open Pit Precious Metal Mines	02/15 /1994			EPA530-R-95-011
164) U.S. Fish and Wildlife Service 3 year monitoring program/study at New Almaden Mine (San Jose California); mercury contamination at issue		John Hillen brand, Regio n 9		
165) EPA, Office of Solid Waste 1978. Compilation and Evaluation of Leaching Methods.				EPA/600/ 2/78/095
166) MacDonald, M. S., G. C. Miller, and W. B. Lyons. 1994. Water Quality in Open Pit Precious Metal Mines. University of Nevada, Reno.				EPA/530/ R/95/011, PB95-191 243.

<u>II. EPA’s Office of Air and Radiation, Office of Radiation and Indoor Air (OAR.ORIA) Items:</u>

Because ORIA only deals with radionuclides (e.g., from phosphate mining and uranium mining) ORIA’s items are listed separately.

Topic Area 1: Characterization/Monitoring

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

167) MARSSIM-a multi agency technical document designed to guide and assist in the demonstration of compliance with radiation dose or risk-based cleanup standards. This guidance provides a performance-based approach for demonstrating compliance with a dose or risk based regulation.	Dec 1997	Oria L V Lab/HQ	Mark Doehnert 202 564 9386	EPA 402-R-97-016
168) Multi-Agency Radiation Laboratory Analytical Protocols Manual (MARLAP). This guidance provides a performance-based approach for methods to determine the radiation activities in soil and water.	Ongoing	NAREL	John Griggs 334 270 3450	In Peer Review

Topic Area 3: Fate/Transport

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
169) Understanding Variation In Partition Coefficient, KD, Values. Volume 1: The Kd Model Of Measurement, And Application Of Chemical Reaction Codes. Volume 2: Review of Geochemistry And Available Geochemistry And Available Kd values For Cadmium, Cesium, Chromium, Lead, Plutonium, radon, Strontium, Thorium, Tritium , And Uranium. Volume 1 gives methods for measurement including an insitu field measurement. Volume 2 provides a description of dominant chemical mechanism responsible for aqueous concentration reduction. Recommend measurement for site specific application.	Aug 99	Ron Wilhelm	202 564 9379	EPA402-R-99-004A&B
170) REVIEW OF SURFACE COAL MINING EMISSION FACTORS	Aug 99	Ron Wilhelm	202 564 9379	EPA402-R-99-004A&B
171) Estimation of Infiltration Rate in the Vadose Zone: Compilation of Simple Mathematical Models, Vol 1 & 2. These reports provide an extensive compilation of methods, in addition to a categorization of those methods. Use of these models will provide a rational and scientific basis for remedial decision-making related to soil contaminant levels. This project was funded by ORIA. The work was conducted and published by ORD NRMR lab, Ada, OK.	Feb 1998	Williams /Ada, Anderson&Wilhelm/ORIA	202 564 9379	EPA/600/R-97/128a&b

172) Characterization and Measurement of the Hydraulic Properties of Unsaturated Porous Media, Part 1 & 2. Proceedings document workshop in 1997. Reviews the various aspects of water flow and solute transport in unsaturated porous media,. Provides information on the unsaturated zone hydraulic properties and modeling. M. Th. Van Genuchten , University of California, was the project coordinator. Published in book form and sponsored by EPA/ORIA and other federal agencies.	1999	M. Th. Genuchten/workshop coodinator; Ron Wilhelm EPA sponsor	202 564 9379	Uni. Of CA, Riverside.

Topic Area 5: Risk Assessment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
173) EPA, Office of Radiation and Indoor Air. 1993. Diffuse NORM Wastes and Waste Characterization and Preliminary Risk Assessment.				RAE-9232/1-2. Contract # 68-D20-155

Topic Area 6: Remediation and Treatment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
174) Fry Canyon Field Demonstration Project . This is an ongoing demonstration of a Permeable Reactive Barrier wall to control aqueous concentrations of Uranium in ground water at an abandoned mill tailings site in Utah. Three different materials have been installed (phosphate, zero valent iron, and amorphous iron hydroxide). Draft report 1999.	Ongoing/ 2000	ORIA Ed Feltcorn	202 564 9422	In Peer Review.

175) Mixed Waste Stabilization/Solidification Demonstration Project. This ongoing project is evaluating 4 solidification technologies and protocols for assessing the leaching of radionuclides and long term durability. Lab bench tests have been completed with cement, phosphate, polymer, and vinyl ester styrene.	Draft in Peer review	ORIA/ Tri Hoang	202 564 9713	Draft in Peer Review.
176) Phtyoremediation of radionuclides by plants. This project is investigating the use of plants in remediation of radionuclides. Phtoextraction is of interest as one of the primary mechanisms. IAG with USDA.	Draft received	ORIA HQ	202 564 9379	Draft

III. EPA ORD-NCERQA Program and Solicitation Information (not including Butte Montana projects):

Topic Area 1: Characterization/Monitoring

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
177) The Characterization and Treatment of Hazardous Materials from Metal Mineral Processing Wastes The objective is to develop processing procedures to treat waste oxides generated by the mining and metals industry.	Ongoing; no schedule	O'Keefe, Watson, Great Plains/Rocky Mountain Hazardous Substance Research Center (HSRC), (includes EPA Regions 7 and 8)	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

178) Development of Chemical Methods to Assess the Bioavailability of Arsenic in Contaminated Media Assessing the ability of chemical methods (chemical speciation, in-vitro gastrointestinal) to estimate As bioavailability in contaminated media and provide rapid inexpensive data to characterize risk at Superfund sites. In this study, As measured by chemical methods (chemical speciation and in-vitro gastrointestinal methods) will be compared with As uptake by immature pigs for contaminated media (soil and slag) collected from a mining, milling, and smelter site. Goal is to provide rapid, inexpensive methods to obtain site-specific scientifically derived bioavailability data to select appropriate remedies, evaluate effectiveness and determine remediation endpoints.	10/99	Nicholas T. Basta, Robin R. Rodriguez ,and Stan W. Casteel, Oklahoma St. University; U of Missouri-Columbia	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
179) Processes Controlling the Chemical/Isotopic Speciation and Distribution of Mercury from Contaminated Mine Sites: Discusses how we can best understand the physical and chemical processes that control the speciation and distribution of Hg in mine wastes and its release from mine sites.	10/1/99 to 9/30/02	EPA Project Officer: Bill Stelz; Gordon Brown; Stanford University ,	Bill Stelz: 202-564-6834 Brown, 650-723-9168; gordon@pangea.stanford.edu	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 2: Remote Sensing Issues

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

<u>180) Developing Effective Ecological Indicators for Watershed Analysis</u> Will develop improved indicators and innovative techniques for assessing and monitoring ecological integrity at the watershed level in the western United States. Will focus on streams and riparian areas and develop indicators for these areas that reflect the ecological integrity of the associated watersheds. Due to "funnel effects," streams and riparian areas are the accumulation zones of environmental disturbances occurring in their watersheds. Monitoring of key indicators in these accumulation zones will provide an efficient, cost effective way to evaluate and monitor the ecological integrity and sustainability of the surrounding watersheds. The project will focus on the upper Yellowstone River and its tributaries. Effective indicators will be identified, assessed, and validated. This process will involve integration of results from research at various scales, including (1) analysis of hyperspectral and traditional multispectral imagery from both aerial and satellite platforms; (2) surveys of stream morphology and riparian habitat; and (3) intensive site-specific stream sampling. Remote sensing is the primary research methodology: All indicators chosen must be able to be monitored by remote sensing. This will enable these indicators to be used for rapid, cost effective ecological monitoring on the regional and local scale. Remote sensing techniques will be used by project researchers ~Oti! to help identity key ecological indicators in streams and riparian areas and to correlate these indicators with ecological disturbances in the surrounding watersheds. Field surveys will be used with remote sensing to assess indicators. Intensive stream sampling of macroinvertebrate communities will be used to validate the effectiveness of these indicators.	July 1, 1999 to June 30, 2002	Duncan Patten, Yellowstone Ecosystems Studies, et.al., Wayne Minshall, Rick Lawrence, Andrew Marcus, Montana State University Monica Turner, University of Wisconsin, Madison; Don Despain, USGS	dtpatten@mcn.net EPA Project Officer: Barbara Levinson, 202-564-6911	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

Topic Area 3: Fate/Transport

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/Office/Lab	**phone/email**	**Publication number/web address**

181) Fate and Transport of Heavy Metals and Radionuclides in Soil: the Impacts of Vegetation The overall objective of this research is to determine whether establishment of vegetation in heavy metal and radionuclide contaminated soil will significantly affect retention of metals in soils and to mathematically predict the results using a calibrated model. The impact of vegetation and revegetation schemes on the mobility of metals (lead, cadmium, zinc, barium, etc.) is being investigated on contaminated soil and/or mine waste from zinc and lead mining regions of southeast Kansas, lead mines of Montana, and a paint-producing industry in southern Kansas. The following series of experiments will be employed to pursue the objectives: a sequential extraction procedure for determination of various fractions and mineral associations of the metals; batch (laboratory-scale equilibrations) and column experiments to directly assess impact of organic acids on heavy metal mobility; large soil columns to determine effects of vegetation overlying soil depth on mobility of metals and metal uptake by plants; sorption/desorption and determination of potential or existing solid phases of the metals to quantify the soil chemical aspects of metal retention; and integration of geochemical and solute transport modeling to predict and analyze the fate of metals as influenced by the presence of vegetation. Soils and mine tailings have been thoroughly characterized for their important chemical and physical properties as well as the chemical fractions of the metals. Investigators have used x-ray diffraction to identify predominant minerals. Conclusions drawn from this aspect of the study are that high concentrations of readily mobile metals exist in all the soils and tailings, but the predominant fraction depends upon the source of the material. The southeast Kansas mine tailings and soils tend to have the metals present as carbonates and/or sulfides. The Montana mining waste has significant amounts of heavy metals in organic and "unclassified" or residual fractions. Highly contaminated industrial soil from southern Kansas has lead present as oxides and carbonates. These results suggest that metals present in the mining wastes tend to be a long-term threat to the environment as the sulfides and carbonates weather. Lead in the industrial soil can be controlled if the soil is stabilized. Initial batch and column experiments coupled with geochemical modeling have determined that very few naturally occurring organic acids have the capability to mobilize heavy metals, and these acids must be present in concentrations not usually found in soil.	Ongoing; no schedule	A.P. Schwab, M.K. Banks, and L.E. Erickson Kansas State University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

<u>182) Receptor-Based Modeling of Groundwater Contamination</u> This project is assessing the governing equation for source-based mathematical models of contaminant transport in groundwater (the advection-dispersion equation, ADE), with the contaminant concentration as the state variable. Where contamination is detected at one receptor, the equation is solved to obtain a distribution of location probability or travel time probability. If contamination is detected at multiple receptors, the equation will be modified to account for the correlation of multiple detections.	Ongoing; no schedule	RoseannNeupauer New Mexico Institute of Mining and Technology	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
<u>183) Physiochemical and Microbial Controls on the Speciation and Release of Arsenic into Ground and Surface Waters</u> The molecular physiochemical and biological factors affecting the release of As into the environment by weathering of primary arsenic-bearing sulfide minerals will be assessed, focusing on how surface chemical composition and surface microstructure affect the rate of release and oxidation state of arsenic in the aqueous phase. Specific goals include: (1) assess surface phases that form on As-bearing minerals, and how these surface phases alter rate of release and oxidation state of As; (2) assess microstructural defects in controlling As release rates, (3) assess microbial processes that affect As release rate and/or oxidation state, and (4) quantitative understanding of the role of pyrite and other minerals in catalyzing oxidation of As3+ to As5+.	January 1, 1998 - December 31, 2000	Robert J. Hamers and Jillian F. Banfield Institution: University of Wisconsin EPA Project Officer: S. Bala Krishnan	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 4: Control of Releases from Mining Sites

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
184) Evaluation of Natural Amelioration of Acidic Deep Mine Discharges for Watershed Restoration Significant changes in the chemistry of some mine pools and discharges have been observed over time. For example, in several areas of western Pennsylvania, deep mine discharges that were reliably described as highly acidic in the 1960s and 1970s are now alkaline. Because of the natural amelioration of water quality at these sites, low-cost passive treatment techniques are now feasible. However, not all abandoned mine pools undergo, in a 20 year period, a natural amelioration of water quality. This project will investigate the hydrologic and geochemical factors responsible for temporal improvements in mine water quality through study of approximately 30 mine discharges associated with the Uniontown-Connellsville syncline mine pool in Western Pennsylvania.	June 1, 1998 - May 31, 2001	David A. Dzombak, William W. Aljoe Institution: Carnegie Mellon University,	EPA Project Officer: Barbara Levinson, 202-564-6911	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 5: Risk Assessment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address

Topic Area 6: Remediation and Treatment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information

		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
185) Reclamation of Metal and Mining Contaminated Superfund Sites Using Sewage Sludge/Fly Ash Amendments	Ongoing; no schedule	Clevenger, Hinderberger Great Plains/ Rocky Mountain Hazardous Substance Research Center (HSRC), (includes EPA Regions 7 and 8)	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

186) The Characterization and Treatment of Hazardous Materials from Metal Mineral Processing Wastes The objective is to develop processing procedures to treat waste oxides generated by the mining and metals industry.	Ongoing; no schedule	O'Keefe, Watson, Great Plains/ Rocky Mountain Hazardous Substance Research Center (HSRC), (includes EPA Regions 7 and 8), Dale Manty, 202-564-6922	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
187) Acid Producing Metalliferous Waste Reclamation by Material Reprocessing and Vegetative Stabilization This project will attempt to demonstrate an alternative, cost-effective, permanent mine tailing reclamation methodology through the marriage of mineral processing and land reclamation techniques. The approach to be used, Clean Tailing Reclamation (CTR), utilizes potentially field deployable mineral separation technologies to remove dense sulfide minerals from tailing material by gravimetric separation, followed by vegetative stabilization of the cleaned tailing material with native plants. CTR will allow for removal of environmental contaminants and acid-forming materials.	Ongoing; no schedule	F.F. Munshower Montana State University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

188) Metals Soil Pollution and Vegetative Remediation The goal of the research is to determine feasibility and efficacy of vegetative remediation at a variety of sites with heavy metals soil pollution. This project has utilized an abandoned gold mining area near Whitewood Creek, South Dakota, for its investigation. Poplar trees were planted in May 1993, but survival has been compromised by frosts, hail damage, drought, deer browse, and apparent toxicity. Nevertheless, sufficient data have been collected to determine that poplar trees can survive in this relatively harsh environment and that the levels of arsenic and cadmium in leaf tissue are not of concern. In June 1995, there were approximately 150 poplar trees still living from a total of 3,000 that were planted in 1993. The surviving trees were sampled in order to understand long-term uptake and translocation of metals. Most of the poplar trees which grew well were concentrated in a specific area, and their heights were around 3.5 to 4.5 feet. The total number of well-developed poplar trees was approximately 80. The other poplar trees, which grew poorly, were scattered throughout portions of the site, and their heights varied from six inches to two feet. The poorly-developed poplar trees survived with native plants at the site. Fresh leaves and stems were sampled from poplar trees at eight different sites. Dead leaves and stems were collected from the ground where fresh leaves and stems were sampled. Surface soil was also collected from within a one foot radius around each sampled poplar tree. One whole tree was extracted, including roots. Soil samples at depths of 3, 9, 18, and 20 inches were collected from this same area. These samples will be analyzed for arsenic, cadmium, zinc, and lead.	Ongoing; no schedule	J.L. Schnoor, L.A. Licht, M.A. St. Clair, and C. Just; and L.E. Erickson University of Iowa; Kansas State University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
189) Use of Poplar Trees in Remediating Heavy Metal Contaminated Sites Research objectives are to investigate suitability of deep-planted poplars as a vegetative remediation strategy. Addition of manure to the trenches significantly increased growth via increases in height and trunk diameter. The data clearly show that tree cultivar and soil amendments can influence survival and growth parameters. Soil samples have been collected from eight different areas and analyzed for lead concentration. Soil lead concentrations will be compared to leaf tissue lead concentrations after those analyses are complete. This study focuses on an abandoned zinc and lead smelter site in southeast Kansas. The ultimate goal is to immobilize the metals in place. This would be accomplished with grading to 3-5% slope, to encourage runoff without excessive erosion, and the use of rapid growing poplar trees that have a high water demand. This strategy would minimize net percolation through mine spoil material, thus minimizing impact on ground water. Surface erosion would be effectively controlled once the trees are established. A thin soil cover would be employed to establish a perennial grass cover to prevent surface erosion until the trees had become established.	Ongoing; no schedule	Pierzynski, Tracy, Davis, Reddi, Erickson, Schnoor	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

190) Design and Development of an Innovative Industrial Scale Process to Economically Treat Waste Zinc Residues Will design and develop a hydrometallurgical flow sheet to treat waste zinc residues containing iron and other heavy metal impurities such as lead and cadmium. The resulting flow sheet will be used at Big River Zinc Co., or any other industry desiring to treat similar wastes. Will develop metallurgical and chemical processes to treat these hazardous wastes in an economically viable manner, using galvanic stripping process to separate iron from zinc. Will develop in-line processes for handling low concentration impurities in feed stock. Will evaluate process parameters to optimize reduction of Fe+3 to Fe+2 in the D2EHPA organic phase; determe type of aqueous stripping solution and design procedure alternatives to separate and recover Fe+2, and identify influence of various heavy metal impurities.	Ongoing; no schedule	T.J. O'Keefe University of Missouri	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
191) Biofilm Barriers for Waste Containment to determine through bench-scale tests the feasibility of using biologically modified soils as waste containment barriers. This project will involve developing new, low-cost barrier materials bioengineered for waste containment. a series of bench-scale tests will be performed to measure changes in hydraulic conductivity of soils treated with ultramicrobacteria (UMB) compared to untreated soils. The project will investigate the range of biological conditions under which UMBs have the ability to reduce soil hydraulic conductivity. Based on results of bench-scale tests, investigators will establish the range of physical and biological parameters most likely to result in successful application of biofilm technology to the design and construction of field-scale waste barriers. Finally, feasibility of using biofilm barriers at the prototype scale will be tested.	Ongoing; no schedule	J.P. Turner, L.E. Bulla, and Q.D. Skinner, University of Wyoming	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
192) Detoxification of Metal-Contaminated Industrial Effluents Using Shellfish Processing Wastes Will assess use of shell wastes recovered from shellfish processors as "secondary raw materials" to adsorb dissolved metals found in high concentrations in industrial effluents, at Superfund sites, and from soil-washing operations, to produce a compact, pH-stable, "pelletized" residue for easy disposal. Will assess kinetics of metal uptake and sorption isotherms and develop mechanistic predictive models.	Ongoing; no schedule	Helen E.A. Tudor, Columbia University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

193) Vegetative Interceptor Zones for Containment of Heavy Metal Pollutants Will assess efficacy of different plant and microbial regimes in reducing surface water contamination from revegetated plots, and the ability of various vegetation/microbial regimes to act as buffer strips. Revegetation of Superfund and non-Superfund areas will be undertaken to stabilize the sites and reduce wind and water erosion from the tailings. Both the ability of various vegetation regimes to limit surface water erosion and spread of heavy metal contamination, and the ability of these vegetation regimes to act as interceptor strips for contamination uphill from the vegetation strips will be studied in this project.	Ongoing; no schedule	B.A.D. Hetrick; Pierzynski, Erickson, Govindaraju and Sweeney, U of Northern Iowa; Kansas State Univ.	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 7: Environmental Effects (i.e., physical/chemical effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

<u>194) Geochemical, Biological and Economic Effects of Arsenic and Other Oxyanions on a Mining Impacted Watershed</u> This research will focus on the geochemical, biological and economic impacts of As released during mining in the Humboldt River watershed in northern Nevada. Mines in this watershed produced 4.9 million ounces of gold in 1994, which was nearly half of the nation's production of gold in that year. The geochemical investigations will focus on models used to predict precious metals pit lake water quality, particularly with respect to As sorption on metal oxides (DRI project). Investigations will examine both As sorption by precipitates in present pit lakes and factors which influence As release as a function of wall rock-water interactions. A second geochemical focus will be to understand the hydrologic and geochemical release of constituents from heaps, focusing on prediction of As discharge from the base of the heaps (UNR project). Because As sorption is dependent on both the pH of the solution and surface mineralogy, methods to predict As discharge from these heaps are required for long-term management. Using both column studies and actual decommissioned heaps, we will couple hydrologic and geochemical models in order to better understand these systems. The biological investigations of arsenic (LBL project) will focus on the genotoxic and developmental response of a variety of organisms to mine-impacted water, particularly pit lakes. These data are necessary to better understand whether the lakes can be used as wildlife habitat or if they present a significant risk to native or introduced species. We will also investigate how water quality (with an emphasis on As) and water quantity will affect recreational and agricultural uses of the Humboldt River watershed (UNR project). These studies will examine the present uses of water in the Humboldt River watershed, and how that water will be affected by changes resulting from present and future mining.	12/99	Glenn Miller, Watkins W. Miller, Scott Tyler, Douglass Shaw, Ron Hershey, Lambis Papelis, Susan Anderson, University of Nevada Reno; Desert Research Institute; Lawrence Berkeley Laboratory	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

195) Mercury and Iron Biogeochemistry The primary focus of this project is to understand better the sediment processes controlling Hg methylation and internal loading by nutrients. With respect to nutrient loading, this project is closely tied to our recently completed "Clean Lakes" project (which focused on eutrophication). The Hg work is closely coordinated with our ongoing EPA Superfund project associated with contamination from the Sulphur Bank Mercury Mine. The primary goals of the Superfund project are: 1. to characterize the distribution of Hg in the important physical and biological compartments of Clear Lake including: water, sediments, benthic invertebrates, plankton, fish and birds, and 2. to evaluate sediment and water column processes that are responsible for Hg methylation within this system. A preliminary survey of Hg in the major physical and biological compartments was conducted during fall 1992 and a two-year survey of seasonal trends in total Hg, methyl Hg and methylation potential was expected completion, May 1996. Relatively high peaks of both total Hg and (unexpectedly) methyl Hg were found in sediment cores dated to the mid 1940's, associated with periods of intense mining activity. We completed a series of microcosm experiments designed to evaluate methylation potential under varying environmental conditions and are now in the process of designing experiments to evaluate methylation potential in deep sediments, which will help explain why methyl Hg peaks remain stable for long periods of time within deep regions of the sediment column. Several publications resulting from these studies are published, in press or in preparation (see publications by Suchanek et al.). Another student with support from Savannah River Ecological Laboratory, is investigating the effects of the Hg gradient in Clear Lake on benthic invertebrate population genetics. The Decision Support Core is providing an important transport modeling component to this and the microbial processes project. The Analytical Core is also providing analytical tools and services for the analysis of Hg, arsenic and unknown compounds found associated with the Sulphur Bank Mercury Mine.	6/95	University of Cal-Davis	Thomas Suchanek and Peter Richerson, Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

196) Processes Controlling the Chemical/Isotopic Speciation and Distribution of Mercury from Contaminated Mine Sites This project will (1) determine the chemical and isotopic speciation of Hg in natural samples; (2) examine the transport of Hg on colloidal particles in laboratory column experiments; (3) examine sorption processes of Hg on mineral particles common in sediments downstream from mine sites, and the effects of sulfate and chloride on Hg sorption processes; and (4) monitor atmospheric emission of Hg from selected mine waste sites and correlate emission levels with the chemical speciation of Hg in the mine wastes. Chemical and isotopic speciation of Hg in natural samples using modern spectroscopic and isotopic methods, X-ray diffraction (XRD) and electron probe microanalysis (EPMA). will utilize synchrotron radiation-based X-ray absorption fine structure (XAFS) spectroscopy to determine quantitatively and directly the chemical speciation of Hg in contaminated natural samples. Will determine isotopic fractionation of Hg in soil, pile, sediment and fish samples at spatial resolutions of one µm or less using secondary ion mass spectrometer. Will assess changes in Hg isotopic fractionation by secondary transformation processes, including methylation by sulfate-reducing bacteria. Will examine Hg transport by colloids, assess sources and characteristics of mobile colloidal particles, colloid-Hg interactions, and persistence of suspended particles in aquatic systems, using acid digestion, inductively coupled plasma (ICP), EPMA, XRD, ultrafiltration, ultracentrifugation, transmission electron microscopy, atomic force microscopy, BET surface area measurements, light scattering, macroscopic batch uptake experiments, cold vapor atomic absorption spectroscopy, and XAFS methods. Precipitation phenomena: will use thermodynamic modeling and batch reactor studies Sorption of Hg on mineral particles. Will identify molecular-scale mode of Hg sorption to particles Hg over time. Will assess Hg sorbtion to iron oxyhydroxides and clays, and assess how chloride and sulfate inhibit Hg sorption through formation of stable aqueous Hg complexes. Will generate a molecular-scale model for Hg sorption. Atmospheric emission of Hg. Will assess atmospheric Hg emissions linked to Hg speciation in mine wastes (measured through XAFS spectroscopy). Emissions will be measured from each site. Will develop an area emission model that accounts for factors controlling Hg emissions.	10/1/99 to 9/30/02	Gordon E. Brown, Jr. Trevor R. Ireland, Mae S. Gustin, James J. Rytuba (collaborator), Daniel Grolimund, Christopher S. Kim Stanford University, Stanford, CA (Brown, Ireland, Grolimund, Kim), University of Nevada-Reno, (Gustin), U.S. Geological Survey, Menlo Park, CA (Rytuba)	Gordon E. Brown, Jr. (gordon@pangea.stanford.edu), EPA Project Officer: Barbara Levinson, 202-564-6911	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

197) Arsenic Cycle at the Harvard Mine Pit Lake, Mother Lode Gold District, California To identify the mineral sources of arsenic contributing to elevated arsenic concentrations in the Harvard Mine pit lake, and to evaluate the effects of seasonal variations in rainfall and lake stratification on arsenic distribution and speciation in the alkaline aquatic environment. Mapping focuses on possible controls for secondary mineral development, including modal abundance, composition and grain size of sulfides, carbonate content of wall rocks (which can control local fluid composition in contact with mineral surfaces), and outcrop surface area. Papers and Publications:	12/2000	Kaye Savage Department of Geological and Environmental Sciences Stanford University	Dale Manty, ORD/NCERQA, 202-564-6922	Savage, K.S., et.al.; Atomic environment of arsenic in mine waste rock, tailings and their weathering products at Don Pedro Reservoir, California. Proceedings, Soc. for Envtl.Geoche mistry and Health, 3d Internl. Conf. on Arsenic Exposure and HealthEffects, http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 8: Ecological (i.e., biological/ecosystem effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

198) Geochemical, Biological and Economic Effects of Arsenic and Other Oxyanions on a Mining Impacted Watershed This research will focus on the geochemical, biological and economic impacts of As released during mining in the Humboldt River watershed in northern Nevada. Mines in this watershed produced 4.9 million ounces of gold in 1994, which was nearly half of the nation's production of gold in that year. The geochemical investigations will focus on models used to predict precious metals pit lake water quality, particularly with respect to As sorption on metal oxides (DRI project). Investigations will examine both As sorption by precipitates in present pit lakes and factors which influence As release as a function of wall rock-water interactions. A second geochemical focus will be to understand the hydrologic and geochemical release of constituents from heaps, focusing on prediction of As discharge from the base of the heaps (UNR project). Because As sorption is dependent on both the pH of the solution and surface mineralogy, methods to predict As discharge from these heaps are required for long-term management. Using both column studies and actual decommissioned heaps, we will couple hydrologic and geochemical models in order to better understand these systems. The biological investigations of arsenic (LBL project) will focus on the genotoxic and developmental response of a variety of organisms to mine-impacted water, particularly pit lakes. These data are necessary to better understand whether the lakes can be used as wildlife habitat or if they present a significant risk to native or introduced species. We will also investigate how water quality (with an emphasis on As) and water quantity will affect recreational and agricultural uses of the Humboldt River watershed (UNR project). These studies will examine the present uses of water in the Humboldt River watershed, and how that water will be affected by changes resulting from present and future mining.	12/99	Glenn Miller, Watkins W. Miller, Scott Tyler, Douglass Shaw, Ron Hershey, Lambis Papelis, Susan Anderson, University of Nevada Reno; Desert Research Institute; Lawrence Berkeley Laboratory	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

199) Fate and Transport of Heavy Metals and Radionuclides in Soil: the Impacts of Vegetation The overall objective of this research is to determine whether establishment of vegetation in heavy metal and radionuclide contaminated soil will significantly affect retention of metals in soils and to mathematically predict the results using a calibrated model. The impact of vegetation and revegetation schemes on the mobility of metals (lead, cadmium, zinc, barium, etc.) is being investigated on contaminated soil and/or mine waste from zinc and lead mining regions of southeast Kansas, lead mines of Montana, and a paint-producing industry in southern Kansas. The following series of experiments will be employed to pursue the objectives: a sequential extraction procedure for determination of various fractions and mineral associations of the metals; batch (laboratory-scale equilibrations) and column experiments to directly assess impact of organic acids on heavy metal mobility; large soil columns to determine effects of vegetation overlying soil depth on mobility of metals and metal uptake by plants; sorption/desorption and determination of potential or existing solid phases of the metals to quantify the soil chemical aspects of metal retention; and integration of geochemical and solute transport modeling to predict and analyze the fate of metals as influenced by the presence of vegetation. Soils and mine tailings have been thoroughly characterized for their important chemical and physical properties as well as the chemical fractions of the metals. Investigators have used x-ray diffraction to identify predominant minerals. Conclusions drawn from this aspect of the study are that high concentrations of readily mobile metals exist in all the soils and tailings, but the predominant fraction depends upon the source of the material. The southeast Kansas mine tailings and soils tend to have the metals present as carbonates and/or sulfides. The Montana mining waste has significant amounts of heavy metals in organic and "unclassified" or residual fractions. Highly contaminated industrial soil from southern Kansas has lead present as oxides and carbonates. These results suggest that metals present in the mining wastes tend to be a long-term threat to the environment as the sulfides and carbonates weather. Lead in the industrial soil can be controlled if the soil is stabilized. Initial batch and column experiments coupled with geochemical modeling have determined that very few naturally occurring organic acids have the capability to mobilize heavy metals, and these acids must be present in concentrations not usually found in soil.	Ongoing; no schedule	A.P. Schwab, M.K. Banks, and L.E. Erickson Kansas State University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

200) Development of Chemical Methods to Assess the Bioavailability of Arsenic in Contaminated Media This research will try to determine the ability of chemical methods (chemical speciation, in-vitro gastrointestinal) to provide a reasonable estimate of As bioavailability in contaminated media and provide rapid and inexpensive information to characterize risk at Superfund sites. In this study, As measured by chemical methods (chemical speciation and in-vitro gastrointestinal methods) will be compared with As uptake by immature pigs for contaminated media (soil and slag) collected from a mining, milling, and smelter site. Benefits expected from the proposed research include inexpensive methodologies to obtain site-specific bioavailability thereby lowering the degree of uncertainty in risk assessment. Rapid, inexpensive testing methods will provide scientifically derived data to select appropriate remedies at these sites which are cost-effective and protective of human health and the environment. An accurate site-specific bioavailability method may be a useful tool to evaluate the effectiveness of remediation technologies and determine remediation endpoints.	10/99	Nicholas T. Basta, Robin R. Rodriguez,and Stan W. Casteel, Oklahoma State University; University of Missouri-Columbia	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
201) Effects of Surfactants on the Bioavailability and Biodegradation of Contaminants in Soils A series of contaminant partitioning studies using a wide range of surfactants with varying structures will be performed. Functional relationships between surfactant concentration, surfactant structure, and extent of contaminant solubilized will be established using batch and column studies. Effects of surfactants on subsequent biodegradation rates of phenanthrene, PCP, DDT, and PCB will be studied under batch and transport conditions using two representative bioremediation strategies: indigenous microbial populations and addition of white-rot fungi. Degradation rates will be determined under batch and transport conditions in previously unconates fate of heavy metals in a vegetated soil and to use the model to develop a protocol for determining the most effective vegetative planting strategies for immobilizing heavy metals in contaminated soil.		W.P. Inskeep and J.M. Wraith; C.G. Johnston Institution: Montana State University; Mycotech Corporation	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

202) Developing Effective Ecological Indicators for Watershed Analysis Will develop improved indicators and innovative techniques for assessing and monitoring ecological integrity at the watershed level in the western United States. Will focus on streams and riparian areas and develop indicators for these areas that reflect the ecological integrity of the associated watersheds. Due to "funnel effects," streams and riparian areas are the accumulation zones of environmental disturbances occurring in their watersheds. Monitoring of key indicators in these accumulation zones will provide an efficient, cost effective way to evaluate and monitor the ecological integrity and sustainability of the surrounding watersheds. The project will focus on the upper Yellowstone River and its tributaries. Effective indicators will be identified, assessed, and validated. This process will involve integration of results from research at various scales, including (1) analysis of hyperspectral and traditional multispectral imagery from both aerial and satellite platforms; (2) surveys of stream morphology and riparian habitat; and (3) intensive site-specific stream sampling. Remote sensing is the primary research methodology: All indicators chosen must be able to be monitored by remote sensing. This will enable these indicators to be used for rapid, cost effective ecological monitoring on the regional and local scale. Remote sensing techniques will be used by project researchers ~Oti! to help identity key ecological indicators in streams and riparian areas and to correlate these indicators with ecological disturbances in the surrounding watersheds. Field surveys will be used with remote sensing to assess indicators. Intensive stream sampling of macroinvertebrate communities will be used to validate the effectiveness of these indicators.	July 1, 1999 to June 30, 2002	Duncan Patten, Yellowstone Ecosystems Studies, et.al., Wayne Minshall, Rick Lawrence, Andrew Marcus, Montana State University Monica Turner, University of Wisconsin, Madison; Don Despain, USGS	dtpatten@mcn.net EPA Project Officer: Barbara Levinson, 202-564-6911	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
203) Microbiological Processes in Sediments Studying the microbiology of Hg methylation in Clear Lake sediments. Monitoring sulfate reduction rates and Hg methylation potentials. Vertically stratified cores of lake sediments and slurries made from these cores were used to model the different processes. Examining the effects of molybdate on Hg methylation potential and sulfate reduction rates. Development of an in-house method for measurement of methyl Hg.	On going; no schedule	Douglas Nelson, (Cal-Davis)	Dale Manty, OR D/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 9: Technical Transfer (i.e., what information exchange is occurring)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information

		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address

Topic Area 10: Other Documents/Projects

Question: Any thoughts on whether you'd find it useful to listing out all projects in the region, coupled with the regulatory status of each?

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/ yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
204) Superfund Sites and the Mineral Industries Methods This research will try to determine whether mining and mineral processing methods of analysis and testing could be applied to Superfund Sites. Three different superfund site samples, analysis for metal contaminants: lead, arsenic and chromium, and for all possible contaminants using neutron activation; followed by wet screen analysis of all samples using 28, 35, 48, 65, 100, 150, and 200 mesh screens and analyzing each portion for contaminant ingredients; water used for wet screening will be analyzed (probably using ICP method) to see if there is significant solubilization. Depending on the the analyses results, and looking at the particles under magnification, it should be possible to determine if the contaminants are in prous solids, as a stain on the particles, etc. We will then develop test methods (bench scale) to determine how we will separate the contaminants by solubilization, classification or other methods to recover the toxic or hazardous materials. Requirements for the particular metals separation will be devised and tested for removal to meet EPA standards. This will alow the development and separation of the toxic or hazarodous metals in the flowsheet calculating all stream quantities and concentrations. Thus, we will end up with a product meeting EPA requirements and it can de disposed back in the original location. The separated toxic and hazardous wastes must be tested for resolubilization by the EPA method so this fraction can be disposed safely either in the original location or in a safe disposal area. Depending on the concentration of the waste metals that can be produced we will also comment on any possibility of producing products for sale or reuse.	Ongoing; no schedule	Dr. Donald Dahlstrom, University of Utah	Dale Manty, ORD/ NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

Topic Area 11: Modeling and Predictive Tools

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

205) Fate and Transport of Heavy Metals and Radionuclides in Soil: the Impacts of Vegetation The overall objective of this research is to determine whether establishment of vegetation in heavy metal and radionuclide contaminated soil will significantly affect retention of metals in soils and to mathematically predict the results using a calibrated model. The impact of vegetation and revegetation schemes on the mobility of metals (lead, cadmium, zinc, barium, etc.) is being investigated on contaminated soil and/or mine waste from zinc and lead mining regions of southeast Kansas, lead mines of Montana, and a paint-producing industry in southern Kansas. The following series of experiments will be employed to pursue the objectives: a sequential extraction procedure for determination of various fractions and mineral associations of the metals; batch (laboratory-scale equilibrations) and column experiments to directly assess impact of organic acids on heavy metal mobility; large soil columns to determine effects of vegetation overlying soil depth on mobility of metals and metal uptake by plants; sorption/desorption and determination of potential or existing solid phases of the metals to quantify the soil chemical aspects of metal retention; and integration of geochemical and solute transport modeling to predict and analyze the fate of metals as influenced by the presence of vegetation. Soils and mine tailings have been thoroughly characterized for their important chemical and physical properties as well as the chemical fractions of the metals. Investigators have used x-ray diffraction to identify predominant minerals. Conclusions drawn from this aspect of the study are that high concentrations of readily mobile metals exist in all the soils and tailings, but the predominant fraction depends upon the source of the material. The southeast Kansas mine tailings and soils tend to have the metals present as carbonates and/or sulfides. The Montana mining waste has significant amounts of heavy metals in organic and "unclassified" or residual fractions. Highly contaminated industrial soil from southern Kansas has lead present as oxides and carbonates. These results suggest that metals present in the mining wastes tend to be a long-term threat to the environment as the sulfides and carbonates weather. Lead in the industrial soil can be controlled if the soil is stabilized. Initial batch and column experiments coupled with geochemical modeling have determined that very few naturally occurring organic acids have the capability to mobilize heavy metals, and these acids must be present in concentrations not usually found in soil.	Ongoing; no schedule	A.P. Schwab, M.K. Banks, and L.E. Erickson Kansas State University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

206) Receptor-Based Modeling of Groundwater Contamination This project is assessing the governing equation for source-based mathematical models of contaminant transport in groundwater (the advection-dispersion equation, ADE), with the contaminant concentration as the state variable. Where contamination is detected at one receptor, the equation is solved to obtain a distribution of location probability or travel time probability. If contamination is detected at multiple receptors, the equation will be modified to account for the correlation of multiple detections.	Ongoing; no schedule	Roseann Neupauer New Mexico Institute of Mining and Technology	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
207) Detoxification of Metal-Contaminated Industrial Effluents Using Shellfish Processing Wastes Will assess use of shell wastes recovered from shellfish processors as "secondary raw materials" to adsorb dissolved metals found in high concentrations in industrial effluents, at Superfund sites, and from soil-washing operations, to produce a compact, pH-stable, "pelletized" residue for easy disposal. Will assess kinetics of metal uptake and sorption isotherms and develop mechanistic predictive models.	Ongoing; no schedule	Helen E.A. Tudor, Columbia University	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

208) Geochemical, Biological and Economic Effects of Arsenic and Other Oxyanions on a Mining Impacted Watershed This research will focus on the geochemical, biological and economic impacts of As released during mining in the Humboldt River watershed in northern Nevada. Mines in this watershed produced 4.9 million ounces of gold in 1994, which was nearly half of the nation's production of gold in that year. The geochemical investigations will focus on models used to predict precious metals pit lake water quality, particularly with respect to As sorption on metal oxides (DRI project). Investigations will examine both As sorption by precipitates in present pit lakes and factors which influence As release as a function of wall rock-water interactions. A second geochemical focus will be to understand the hydrologic and geochemical release of constituents from heaps, focusing on prediction of As discharge from the base of the heaps (UNR project). Because As sorption is dependent on both the pH of the solution and surface mineralogy, methods to predict As discharge from these heaps are required for long-term management. Using both column studies and actual decommissioned heaps, we will couple hydrologic and geochemical models in order to better understand these systems. The biological investigations of arsenic (LBL project) will focus on the genotoxic and developmental response of a variety of organisms to mine-impacted water, particularly pit lakes. These data are necessary to better understand whether the lakes can be used as wildlife habitat or if they present a significant risk to native or introduced species. We will also investigate how water quality (with an emphasis on As) and water quantity will affect recreational and agricultural uses of the Humboldt River watershed (UNR project). These studies will examine the present uses of water in the Humboldt River watershed, and how that water will be affected by changes resulting from present and future mining.	12/99	Glenn Miller, Watkins W. Miller, Scott Tyler, Douglass Shaw, Ron Hershey, Lambis Papelis, Susan Anderson, University of Nevada Reno; Desert Research Institute; Lawrence Berkeley Laboratory	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')

209) Mercury and Iron Biogeochemistry The primary focus of this project is to understand better the sediment processes controlling Hg methylation and internal loading by nutrients. With respect to nutrient loading, this project is closely tied to our recently completed "Clean Lakes" project (which focused on eutrophication). The Hg work is closely coordinated with our ongoing EPA Superfund project associated with contamination from the Sulphur Bank Mercury Mine. The primary goals of the Superfund project are: 1. to characterize the distribution of Hg in the important physical and biological compartments of Clear Lake including: water, sediments, benthic invertebrates, plankton, fish and birds, and 2. to evaluate sediment and water column processes that are responsible for Hg methylation within this system. A preliminary survey of Hg in the major physical and biological compartments was conducted during fall 1992 and a two-year survey of seasonal trends in total Hg, methyl Hg and methylation potential was expected completion, May 1996. Relatively high peaks of both total Hg and (unexpectedly) methyl Hg were found in sediment cores dated to the mid 1940's, associated with periods of intense mining activity. We completed a series of microcosm experiments designed to evaluate methylation potential under varying environmental conditions and are now in the process of designing experiments to evaluate methylation potential in deep sediments, which will help explain why methyl Hg peaks remain stable for long periods of time within deep regions of the sediment column. Several publications resulting from these studies are published, in press or in preparation (see publications by Suchanek et al.). Another student with support from Savannah River Ecological Laboratory, is investigating the effects of the Hg gradient in Clear Lake on benthic invertebrate population genetics. The Decision Support Core is providing an important transport modeling component to this and the microbial processes project. The Analytical Core is also providing analytical tools and services for the analysis of Hg, arsenic and unknown compounds found associated with the Sulphur Bank Mercury Mine.	6/95	University of Cal-Davis	Thomas Suchanek and Peter Richerson, Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

210) Processes Controlling the Chemical/Isotopic Speciation and Distribution of Mercury from Contaminated Mine Sites This project will (1) determine the chemical and isotopic speciation of Hg in natural samples; (2) examine the transport of Hg on colloidal particles in laboratory column experiments; (3) examine sorption processes of Hg on mineral particles common in sediments downstream from mine sites, and the effects of sulfate and chloride on Hg sorption processes; and (4) monitor atmospheric emission of Hg from selected mine waste sites and correlate emission levels with the chemical speciation of Hg in the mine wastes. Chemical and isotopic speciation of Hg in natural samples using modern spectroscopic and isotopic methods, X-ray diffraction (XRD) and electron probe microanalysis (EPMA). will utilize synchrotron radiation-based X-ray absorption fine structure (XAFS) spectroscopy to determine quantitatively and directly the chemical speciation of Hg in contaminated natural samples. Will determine isotopic fractionation of Hg in soil, pile, sediment and fish samples at spatial resolutions of one µm or less using secondary ion mass spectrometer. Will assess changes in Hg isotopic fractionation by secondary transformation processes, including methylation by sulfate-reducing bacteria. Will examine Hg transport by colloids, assess sources and characteristics of mobile colloidal particles, colloid-Hg interactions, and persistence of suspended particles in aquatic systems, using acid digestion, inductively coupled plasma (ICP), EPMA, XRD, ultrafiltration, ultracentrifugation, transmission electron microscopy, atomic force microscopy, BET surface area measurements, light scattering, macroscopic batch uptake experiments, cold vapor atomic absorption spectroscopy, and XAFS methods. Precipitation phenomena: will use thermodynamic modeling and batch reactor studies Sorption of Hg on mineral particles. Will identify molecular-scale mode of Hg sorption to particles Hg over time. Will assess Hg sorbtion to iron oxyhydroxides and clays, and assess how chloride and sulfate inhibit Hg sorption through formation of stable aqueous Hg complexes. Will generate a molecular-scale model for Hg sorption. Atmospheric emission of Hg. Will assess atmospheric Hg emissions linked to Hg speciation in mine wastes (measured through XAFS spectroscopy). Emissions will be measured from each site. Will develop an area emission model that accounts for factors controlling Hg emissions.	10/1/99 to 9/30/02	Gordon E. Brown, Jr. Trevor R. Ireland, Mae S. Gustin, James J. Rytuba (collaborator), Daniel Grolimund, Christopher S. Kim Stanford University, Stanford, CA (Brown, Ireland, Grolimund, Kim), University of Nevada-Reno, (Gustin), U.S. Geological Survey, Menlo Park, CA (Rytuba)	Gordon E. Brown, Jr. (gordon@pangea.stanford.edu), EPA Project Officer: Barbara Levinson, 202-564-6911	http://es.epa.gov/ncerqa/grants/ (then search for the term ‘mining’)

<u>211) Effects of Surfactants on the Bioavailability and Biodegradation of Contaminants in Soils</u> A series of contaminant partitioning studies using a wide range of surfactants with varying structures will be performed. Functional relationships between surfactant concentration, surfactant structure, and extent of contaminant solubilized will be established using batch and column studies. Effects of surfactants on subsequent biodegradation rates of phenanthrene, PCP, DDT, and PCB will be studied under batch and transport conditions using two representative bioremediation strategies: indigenous microbial populations and addition of white-rot fungi. Degradation rates will be determined under batch and transport conditions in previously unconates fate of heavy metals in a vegetated soil and to use the model to develop a protocol for determining the most effective vegetative planting strategies for immobilizing heavy metals in contaminated soil.		W.P. Inskeep and J.M. Wraith; C.G. Johnston Institution: Montana State University; Mycotech Corporation	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
<u>212) Microbiological Processes in Sediments</u> Studying the microbiology of Hg methylation in Clear Lake sediments. Monitoring sulfate reduction rates and Hg methylation potentials. Vertically stratified cores of lake sediments and slurries made from these cores were used to model the different processes. Examining the effects of molybdate on Hg methylation potential and sulfate reduction rates. Development of an in-house method for measurement of methyl Hg.	Ongoing; no schedule	Douglas Nelson, (Cal-Davis)	Dale Manty, ORD/NCERQA, 202-564-6922	http://es.epa.gov/ncerqa/grants/ (then search for the term 'mining')
213) The objectives of this project are to support research needs for evaluation of anthropogenic activities on aquatic ecosystems and integration of watershed studies at different scales, to conduct a landscape assessment to develop an empirical model that accounts for non-point and point source pollution to streams, to assess the relative risk of the point sources on the environmental condition of the Mid-Atlantic region (MAIA), and to develop a comprehensive and geo-referenced data base of potential pollution point sources with attribute information for the MAIA region. The data base (beginning with Envirofacts) and the methodology will provide the means for stakeholders to be self-reliant in assessments of their local areas and interests.		Bob Schonbrod, ORD/NERL	702-798-2229	
214) EPA, Office of Solid Waste. 1994, Acid Generation Prediction in Mining. Draft.				
215) Technical Document: Acid Mine Drainage Prediction	December 1994			EPA530-R-94-036
216) Strawman II: Recommendations for a Regulatory Program for Mining Wastes and Materials Under Subtitle D of the Resource Conservation and Recovery Act	May 1991			EPA530-SW-91-056

217) Summary of Comments on Mining Waste Report to Congress	05/09/1986			EPA530-SW-86-030
218) Technical Analysis and Evaluation of Mining Site Remediation Costs (not sure who wrote this)	available in early 1997			
219) Water Quality in Open Pit Precious Metal Mines	02/15/1994			EPA530-R-95-011
220) U.S. Fish and Wildlife Service 3 year monitoring program/study at New Almaden Mine (San Jose California); mercury contamination at issue		John Hillenbrand, Region 9		
221) EPA, Office of Solid Waste 1978. Compilation and Evaluation of Leaching Methods.				EPA/600/2/78/095
222) MacDonald, M. S., G. C. Miller, and W. B. Lyons. 1994. Water Quality in Open Pit Precious Metal Mines. University of Nevada, Reno.				EPA/530/R/95/011, PB95-191243.

<u>IV. Other Federal Agencies</u>

Topic Area 1: Characterization/Monitoring

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
223) Lateral Deposition and Geochemical Evolution of Mining-Related Metals in Floodplain Sediments - 9617800601/266-7101 (National Science Foundation)	2000	Scott A Lecce, U of Southern Mississippi, Hattiesburg		http://www.nsf.gov/cgi-bin/showaward?award=9617800

224) U.S.-France Cooperative Research: XAFS Spectroscopic Study of the Chemical Speciation of Lead, Arsenic, and Zinc in Contaminated Soils and Mine Tailings - 9726528 (National Science Foundation)	2001	Gordon E Brown	gordon@pangea.stanford.edu	http://www.nsf.gov/cgi-bin/showaward?award=9726528
225) Characterization of sludges produced in the mitigation of acid mine drainage (U.S. Dept. of Interior, USGS)	2002	Sibrell, Philip L.	304-724-4426	http://cristel.nal.usda.gov:8080/star/brd.html
226) Mercury and Arsenic Contamination at Inactive Mines in the Sierra Nevada and Coast Ranges (U.S. Dept. of Interior, USGS)	2000	Hunerlach, Michael P.	916-278-3000	http://wwwoper.er.usgs.gov/wais/WAIS.ntis.html
227) Study of the Chemical Speciation of Lead, Arsenic, and Zinc in Contaminated Soils and Mine Tailings (National Science Foundation)				gordon@pangea.stanford.edun/showaward?award=972 6528
228) Ground-Water Monitoring Network Design (U.S. Dept. of Interior, USGS)		Brian Wagner	415-329-4567	http://wwwrvares.er.usgs.gov/nrp/proj.bib/wagner.html
229) Distribution and Speciation of Metals in Sedimentary Environments (U.S. Dept. of Interior, USGS)		Nancy S. Simon	703-648-5863	http://wwwrvares.er.usgs.gov/nrp/proj.bib/simon.html
230) Sediment-Transported Pollutants in the Mississippi River (U.S. Dept. of Interior, USGS)		Robert H. Meade, Jr.	303-236-5009	http://wwwrvares.er.usgs.gov/nrp/proj.bib/miss.html
231) Comprehensive Organic Analysis of Water (U.S. Dept. of Interior, USGS)		Jerry A. Leenheer	303-467-8290	http://wwwrvares.er.usgs.gov/nrp/proj.bib/leenheer.html
232) Applying a Bioassessment and Monitoring Framework for Public Lands and Trust Resources Along the Atlantic Coast (U.S. Dept. of Interior, USGS)	1999	Barnett A. Rattner	Barnett_Rattner@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/rattnr2s.html

233) Amargosa Desert Research Site, Nevada, Contaminants in Arid Environments (U.S. Dept. of Interior, USGS)	December 1985	ADRS Webserver Team	adrs_nv@usgs.gov	http://toxics.usgs.gov/toxics/sites/adrs_page.shtml
234) (U. S. Geological Survey, Menlo Park, CA, United States), Mercury in waters and sediments of the Wilbur hot springs area,		Janik, Cathy J. Goff, Fraser (non-survey author), Rytuba, James J., Counce, Dale (non-survey author),		USGS ref # 1997-002931.
235) A Conceptual Waste Rock Sampling Program for Mines Operating in Metallic Sulfide Ores with a Potential for Acid Rock Drainage. Ogden, Utah: USDA, Forest Service.	1992.	U.S. Forest Service.		
236) The distribution and bioavailability of metal contaminants in a mining impacted river, Abstracts of papers, 216th American Chemical Society national meeting,		Cain, D. J. (U. S. Geological Survey, Menlo Park, CA, United States), Luoma, S. N., Axtmann, E. V., Hornberger, M. I.,		USGS ref # 1998-065930
236.1) Preliminary Assessment Report and Site Assessment report, and preliminary score sheet-Back Rock Mine (BLM, California)	Dec. 1990	Cheryl Seath; BLM, Bishop F.O.	(760)872-4881.	contract # AA852-CTO-0026
236.2) Preliminary Assessment Report- Swansea Site (BLM, California)	Dec. 1990	Cheryl Seath; BLM Bishop F.O.	(760)872-4881.	contract # AA852-CTO-0026
236.3) Preliminary Assessment Report - and preliminary scoresheet- Bodie Mine site, CERCLIS (BLM, Calif.)	Oct. 1994	Cheryl Seath; BLM Bishop F.O.	(760)872-4881.	CA3141190568
236.4) Red Devil Mine Site Investigation, Red Devil, Alaska: BLM; Weston, Roy F., Inc.	1989	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	

Topic Area 2: Remote Sensing Issues

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

Topic Area 3: Fate/Transport

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Office	**phone/ email**	**Publication number/ web address**
237) ABIOTIC REDUCTIVE REACTIONS OF ORGANIC COMPOUNDS ON MICROBIALLY REDUCED CLAY MINERALS (U.S. Department of Agriculture)	2000	Stucki, J. W. UNIV OF ILLINOIS, URBANA, IL		http://cristel.nal.usda.gov:8080/
238) ADSORPTION AND ABIOTIC DEGRADATION OF ORGANIC CHEMICALS ON SOIL MINERAL SURFACES (U.S. Department of Agriculture)	1999	Ukraincz yk, L. IOWA STATE UNIV., AMES, IA		http://cristel.nal.usda.gov:8080/
239) ABIOTIC DEGRADATION OF ORGANIC CHEMICALS , THROUGH INTERACTION WITH DISSOLVING MINERALS (U.S. Department of Agriculture)	2001	Casey, W. H. UNIV OF CALIFORNIA. DAVIS, CA		http://cristel.nal.usda.gov:8080

240) The Influence of Temperature from 25 to 295 C on Ion Adsorption at Mineral Surfaces - 9627784 (National Science Foundation)	2000	Michael L Machesky	machesky@uiuc.edu	http://www.nsf.gov/cgi-bin/showaward?award=9627784
241) RELEASE AND TRANSPORT OF METALS FROM MINING SITES - 5P42ES04705-130018 (National Institute of Health)	2000	HUNT, JAMES R., UNIV OF CALIFORNIA BERKELEY		https://www-commons.cit.nih.gov/crisp/
242) Release And Transport Of Metals From Mining Sites (National Institutes of Health)	1998	Hu, Horward Monson, Richard R. Harvard University		gopher://gopher.nih.gov:70/0R129563388-129568815-/gopherlib/data/crisp/Nov01/GOPHER.DATA
243) Reaction-Transport Modeling in Ground-Water Systems (U.S. Dept. of Interior,		David L. Parkhurst	303-236-5098	USGS)http://wwwrvares.er.usgs.gov/nrp/proj.bib/parkhurst.html
244) Kinetics and Thermodynamics of Chemical Evolution in Ground-Water Systems (U.S. Dept. of Interior, USGS)		L. Niel Plummer	703-648-5841	http://wwwrvares.er.usgs.gov/nrp/proj.bib/plummer.html
245) Transport and Biogeochemical Fate of Organic Substances in Aquatic Environments U.S. Dept. of Interior, USGS		Robert P. Eganhouse	703-648-5879	http://wwwrvares.er.usgs.gov/nrp/proj.bib/eganhouse.htm
246) Dispersion of Toxic and Radioactive Wastes in Ground-Water System (U.S. Dept. of Interior, USGS)		Warren W. Wood	703-648-5875	http://wwwrvares.er.usgs.gov/nrp/proj.bib/wood.html
247) Comparative Study of Organic Degradation in Selected Hydrologic Environments (U.S. Dept. of Interior, USGS)		Mary Jo Baedecker	703-648-5833	http://wwwrvares.er.usgs.gov/nrp/proj.bib/baedecker.html

248) Ground-Water Solute-Transport Simulation (U.S. Dept. of Interior, USGS)		Kenneth L. Kipp	303-236-4991	http://wwwrvares.er.usgs.gov/nrp/proj.bib/kipp.html
249) Partitioning of Solutes between Solid and Aqueous Phases (U.S. Dept. of Interior, USGS)		James A. Davis	415-329-4484	http://wwwrvares.er.usgs.gov/nrp/proj.bib/davis.html
250) Geochemistry of Clay-Water Reactions (U.S. Dept. of Interior, USGS)		Dennis D. Eberl	303-541-3028	http://wwwrvares.er.usgs.gov/nrp/proj.bib/eberl.html
251) Non Isothermal Multiphase Flow (U.S. Dept. of Interior, USGS)		William N. Herkelrath	415-354-3314	http://wwwrvares.er.usgs.gov/nrp/proj.bib/herkelrath.html
252) Digital Modeling of Transport in the Saturated Zone (U.S. Dept. of Interior, USGS)		Leonard F. Konikow	703-648-5878	http://wwwrvares.er.usgs.gov/nrp/proj.bib/konikow.html
253) Evaluation of Major and Trace Elements in Acid Mine Waters and Ground Waters (U.S. Dept. of Interior, USGS)		Darrell K. Nordstrom	303-541-3037	http://wwwrvares.er.usgs.gov/nrp/proj.bib/nordstrom.html
254) Fate and Transport of Immiscible Contaminants in the Subsurface (U.S. Dept. of Interior, USGS)		Hediff I. Essaid	415-354-3383	http://wwwrvares.er.usgs.gov/nrp/proj.bib/essaid.html
255) Fate of Organic Chemicals in Subsurface Environments (U.S. Dept. of Interior, USGS)		Edward M. Godsy	415-329-4504	http://wwwrvares.er.usgs.gov/nrp/proj.bib/godsy.html
256) Behavior of Natural Polyelectrolytes in Water (U.S. Dept. of Interior, USGS)		Robert L. Wershaw	303-467-8280	http://wwwrvares.er.usgs.gov/nrp/proj.bib/wershaw.html
257) Organic Carbon Migration in Aquatic Environments (U.S. Dept. of Interior, USGS)		George R. Aiken	303-541-3036	http://wwwrvares.er.usgs.gov/nrp/proj.bib/aiken.html

258) Origin, Fate, and Transport of Organic Compounds in Surface and Ground Waters and Their Effect on Water Quality (U.S. Dept. of Interior, USGS)		Wilfred Pereira	415-329-4599	http://wwwrvares.er.usgs.gov/nrp/proj.bib/pereira.html
259) Solute Transport Involving Biological Processes in Surface Waters (U.S. Dept. of Interior, USGS)		James S. Kuwabara	415-329-4485	http://wwwrvares.er.usgs.gov/nrp/proj.bib/kuwabara.html
260) Investigations of Single and Multiphase Fluid Flow, Mass and Energy Transport, and Fluid Phase Change in the Subsurface Environment (U.S. Dept. of Interior, USGS)		Clifford I. Voss	703-648-5885	http://wwwrvares.er.usgs.gov/nrp/proj.bib/voss.html

Topic Area 4: Control of Releases from Mining Sites

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

Topic Area 5: Risk Assessment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
260.1) Site Assessment Report: BLM Red Top Retort Site, Wood River, Alaska (BLM)	1994	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	

Topic Area 6: Remediation and Treatment

Abstract of Project/Product/Activity; Any Time/Political Constraints?	Schedule (month/yr complete)	Contact Information		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
261) Benefits and Hazards Associated with Sewage Sludge Stabilization of Mine Tailings (U.S. Department of Agriculture)	2002	Pepper, I. L. UNIVERSITY OF ARIZONA, TUCSON, AZ		http://cristel.nal.usda.gov:8080/
262) Decontamination of Soil Containing Residual Mercury from Mining Operations - 9800643 (National Science Foundation)	2000	Quintus Fernando	fernandq@u.arizona.edu	http://www.nsf.gov/cgi-bin/showaward?award=9800643
263) Simulated Effects of Proposed Ground-Water Pumping in 17 Basins of East-Central and Southern Nevada.(USGS)	1995	Schaefer, D. H., and J. R. Harrill.		USGS Water Resources Investigations Report 95-4173.
264) Intermittent fluidization of granular limestone beds with carbon dioxide pretreatment for enhanced restoration of acid mine drainage (U.S. Dept. of Interior, USGS)	1999	Watten, Barnaby, J.	304-724-4425	http://cristel.nal.usda.gov: 8080/star/brd.html
265) Decontamination of Soil Containing Residual Mercury from Mining Operations (National Science Foundation)	2000	Quintus Fernando	fernandq@ccit.arizona.edu	http://www.nsf.gov/cgi-bin/showaward?award=9800643
266) Field Validation Study of a Constructed Wetland System for Wastewater Treatment in the Patuxent River Watershed (U.S. Dept. of Interior, USGS)	1999	Matthew C. Perry	Matt_Perry@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/perry1s.ht
266.1), Final Removal Site Inspection (RSE) Engineering Evaluation / Cost Analysis (EECA) Report - South Pass Mine Sites, Atlantic City, Wyoming: Bureau of Land Management.	March 2000	Ed Heffern, Wyoming SO	(307) 775-6259	Site Evaluation Serv Contract # 1422-N651-C4-3049

266.2) Handbook of Western Reclamation Techniques: U.S. Office of Surface Mining Reclamation and Enforcement, Western Regional Coordinating Center, Office of Technology Transfer, Denver, CO.	1996	Ed Heffern, Wyoming SO	(307) 775-6259	OSM Handbook.
266.3) Final Engineering Evaluation / Cost Analysis (EECA) for Pine Creek Millsites (BLM, ID)	Aug 1998	Coeur D'Alene District, ID		CERCLIS ID # ID1141100114
266.4) Final Removal Site Evaluation and Engineering Evaluation (RSE and EECA), Belle Eldridge Mine and Millsite, S. Dak (BLM, Montana)	Feb 1999	BLM; S. Dakota Resource Area		Contract #1422-N651-C4-3049
266.5) Site Investigations and Engineering Evaluation for determination of a contaminated sited cleanup option for the Red Devil Mine, (BLM Alaska)	2000	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	
266.6) Limited waste removal action report, Red Devil Mine, Red Devil, Alaska: BLM, Alaska	1998	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	
266.7) Engineering evaluation/cost analysis, Red Devil Mine, Red Devil: BLM Alaska	2000	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	
266.8) Remedial Action Report, Red Top Retort Site: BLM, Alaska	1998	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	
266.9) Remedial Action Report: BLM Red Top Retort Site, Wood River, Alaska, Volume 1 & 2: (BLM)	1995	Mike Alcorn, BLM Anchorage FO	(907) 267-1442	

Topic Area 7: Environmental Effects (i.e., physical/chemical effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**

		Name, Region/ Office/ Lab	phone/ email	Publication number/ web address
267) Research in Analytical Environmental Trace Element Chemistry and Its Impact on Water Quality (U.S. Dept. of Interior, USGS)		Howard E. Taylor	303-541-3007	http://wwwrvares.er.usgs.gov/nrp/proj.bib/taylor.html
268) Environmental Dynamics of Persistent Organic Compounds (U.S. Dept. of Interior, USGS)		Cary T. Chiou	303-467-8260	http://wwwrvares.er.usgs.gov/nrp/proj.bib/chiou.html
269) Geochemical Reactions Between Water and Mineral Substrates (U.S. Dept. of Interior, USGS)		Arthur F. White	415-329-4519	http://wwwrvares.er.usgs.gov/nrp/proj.bib/white.ht
270) Cortez Pipeline Gold Deposit: Final Environmental Impact Statement. Volume I. Battle Mountain, Nev.:	1996		U.S. Department of the Interior, BLM.	
271) Simulated Effects of Proposed Ground-Water Pumping in 17 Basins of East-Central and Southern Nevada.	1995	Schaefer, D. H., and J. R. Harrill.		USGS Water Resources Investigations Report 95-4173
272) Crown Jewel Mine: Final Environmental Impact Statement. Tonasket, Wash.: U.S. Forest Service/WSDE (Washington State Department of Ecology)	1997.	U.S. Department of Agriculture, Forest Service; WSDE.		
273) Final Environmental Impact Statement: Zortman and Landusky Mines--Reclamation Plan Modifications and Mine Life Extensions. Volume I. Lewiston, Mont.: U.S. Department of the Interior, BLM; MDEQ.	1996	BLM/MDEQ (Montana Department of Environmental Quality).		

274) Final Environmental Impact Statement: Olinghouse Mine Project. Carson City, Nev.: U.S. Department of the Interior, BLM.	1998.	BLM		
275) Final Environmental Impact Statement: Lisbon Valley Copper Project. Moab, Utah: U.S. Department of the Interior, BLM.	1997	BLM		
276) Ruby Hill Project: Final Environmental Impact Statement. Battle Mountain, Nev.: U.S. Department of the Interior, BLM.	1997	BLM		
277) Final Environmental Impact Statement: Twin Creeks Mine. Winnemucca, Nev.: U.S. Department of the Interior, BLM.	1996	BLM		
278) Overview of long-term effects of surface mining on the ground-water levels and quality in two small watersheds in eastern OhioSkousen,		Cunningham, W. L. (U. S. Geol. Surv., Water Resour. Div., Columbus, OH, United States),		USGS ref # 1991-055300 .
278.1 EIS for expansion of the Santa Rita mine and Cobre mine (open-pit copper mines) by Chino Mines Company. (BLM, New Mexico)	in progress, April 2000	Russell Jentgen Las Cruces FO	505-525-4351.	
278.2) EIS for re-opening of Copper Flat open-pit copper mine (BLM, New Mexico)	in progress, April 2000	Russell Jentgen Las Cruces FO	505-525-4351.	
278.3) Final EIS for Little Rock Mine Project. (Open-pit copper mine, Phelps Dodge): (BLM, New Mexico)	1997	Russell Jentgen Las Cruces FO	505-525-4351.	

278.4) Final EIS for Ruby Hill Project: Open pit gold mine: BLM, Nevada	Jan 1997	Battle Mtn Dist. Office, NV		
278.5) Final EIS for Trenton Canyon Project: Expansion of gold mine operations onto BLM lands, Humboldt and Lander Counties, (BLM, NV)	Aug 1998	Winnemucca DO, NV		
278.6) Impact Evaluation for the Full Development of the Lamefoot Mine, Ferry County, Washington (BLM)	July 1995			Reoort # 1371A/1950714
278.7) Environmental Assessment for Kinross Candelaria Mine Closure (BLM, NV)	Mar 2000	Mike McQueen, Carson City FO		EA # NV-030-00-003
278.8) 3809 mining EIS: Mesquite Mine expansion (draft); BLM, California	In review April 2000	Kevin Marty; El Centro FO	(760) 337-4400	
278.9) 3809 mining EIS: Glamis Imperial Mine (draft); BLM, California	In review April 2000	Glen Miller: El Centro FO	(760) 337-4473	
278.91) Environmental Impact Statement for the Powder River Coal Lease Application (WYW136142) and Thundercloud Coal Lease Application (WYW136458): Bureau of Land Management, Casper District Office	Feb 1998	NancyDoelger BLM, Casper Field Office	307-261-7627.	BLM/WY/PL-98/004+1320, FEIS#98-1.
278.92) Finding of No Significant Impact and Programmatic Environmental Assessment for Selected Actions for Mining Claim and Mill Site Use and Occupancy in Arizona	Nov 1997	Ralph Costa; BLM, AZSO	(602) 417-9349	BLM/AZ/PL-98/002

Topic Area 8: Ecological (i.e., biological/ecosystem effects to the environment)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
279) Manganese and effluent toxicity in acid mine drainage waters: effects on fishes and invertebrates (U.S. Dept. of Interior, USGS)	1999	Krise, William F.	717-724-3322	http://cristel.nal.usda.gov:8080/star/brd.html
280) The distribution and bioavailability of metal contaminants in a mining impacted river, Abstracts of papers, 216th American Chemical Society national meeting,		Cain, D. J. (U. S. Geological Survey, Menlo Park, CA, United States), Luoma, S. N., Axtmann, E. V., Hornberger, M. I.,		USGS ref # 1998-065930.
281) The effects of anthropogenic factors on ecosystems supporting the Neosho madtom (Noturus placidus), with emphasis on historic zinc-lead mining (U.S. Dept. of Interior, USGS)	2000	Mauck, Wilbur L.	573-875-5399	http://cristel.nal.usda.gov:8080/star/brd.html
282) Contamination associated with abandoned mine lands, Bear River and South Fork Yuba River Watersheds: Mercury Contamination of Biota (U.S. Dept. of Interior, USGS)	2000	Mellor, Jack	916-278-3263	http://cristel.nal.usda.gov:8080/star/brd.html
283) USGS study concluded the highest levels of mercury contamination in biota in the Bear River-South Fork Yuba River, California, watersheds was near the largest volume of contaminated mine tailings.		John Hillenbrand, Region 9		

284) Biological impacts of metals from abandoned minelands in the upper Animas River watershed, Colorado (U.S. Dept. of Interior, USGS)	2001	Mauck, Wilbur	573-875-5399	http://cristel.nal.usda.gov:8080/star/brd.html
285) Effects of mining activities on wildlife (U.S. Dept. of Interior, USGS)	2001	Korschgen, Carl E.	608-781-6229	http://cristel.nal.usda.gov:8080/star/brd.html
286) Contaminant effects on fish in the Sacramento River from exposure to heavy metals in acid-mine drainage (U.S. Dept. of Interior, USGS)	2003	Shipley, Frank S.	206-526-6282	http://cristel.nal.usda.gov:8080/star/brd.html
287) Summitville Mine Ecological Risk Assessment (U.S. Dept. of Interior, USGS)		Tom O'Shea	(970) 226-9397	http://www.mesc.usgs.gov/projects/summitville%5Fmine%5Fecological%5Frisk.html
288) Aquatic Toxicology, Aquatic Physical Habitat, and Sediment Analysis in Evaluating Land Mine Remediation Measures (U.S. Dept. of Interior, USGS)		Lee Ischinger	(970) 226-9379	http://www.mesc.usgs.gov/projects/aquatic%5Ftoxicology.html
289) Sources, fate and effects of mercury in aquatic systems at Acadia National Park, ME, and Cape Cod National Seashore, MA (U.S. Dept. of Interior, USGS)	1998	Terry Haines		http://www.lsc.usgs.gov/ael/POSTERS/AELFACTS/AELFRAME.HTM
290) Bats of the Rocky Mountain Arsenal Wildlife Area: Status and Impacts of Contaminants (U.S. Dept. of Interior, USGS)		Lance Everette	(970) 226-9397	http://www.mesc.usgs.gov/projects/bats_of_RMA.html
291) Aquatic Toxicology, Aquatic Physical Habitat, and Sediment Analysis in Evaluating Land Mine Remediation Measures (U.S. Dept. of Interior, USGS)		Lee Ischinger	(970) 226-9379	http://www.mesc.usgs.gov/projects/aquatic%5Ftoxicology.html
292) Sequoia and Kings Canyon National Parks, California; Emerald Lake, Log Meadow, Elk Creek (U.S. Dept. of Interior, USGS)		Claudette Moore	(209) 565-3175	http://www.mesc.usgs.gov/wshed%2Decosys/sequoia%5Fkings.html

292) Restoration, Creation, and Functional Utilization in Western Wetland and Riparian Ecosystems (U.S. Dept. of Interior, USGS)		Lee Ischinger	(970) 226-9379	http://www.mesc.usgs.gov/projects/wetland%5Frestoration%5Fcreation%5Fuse.html
293) Wisconsin Frog and Toad Survey (U.S. Dept. of Interior, USGS)		John R. Sauer	john_r_sauer@nbs.gov	http://biology.usgs.gov/pr/newsrelease/1997/6-10.html
294) Standardized monitoring methods for amphibians in abundance at National Parks and associations between amphibian and environmental stressors (U.S. Dept. of Interior, USGS)		Robin Jung	Robin_Jung@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/droege3s.html
295) Rocky Mountain National Park Inventory and Monitoring Plan (U.S. Dept. of Interior, USGS)		Tom O'Shea	(970) 226-9397	http://www.mesc.usgs.gov/projects/rmnp%5Finventory%5Fmonitoring%5Fplan.html
296) Information Management System for Environmental Contaminants Programs (U.S. Dept. of Interior, USGS)		Don Hunter	970-226-9382	http://www.mesc.usgs.gov/projects/information%5Fmanagement%5Fenvironmental%5Fcontaminants.html
297) Watershed Ecosystem Studies (U.S. Dept. of Interior, USGS)		Ray Herrmann	(970) 491-7825	http://www.mesc.usgs.gov/projects/watershedecosys.html
298) Effects of Toxic Substances on Aquatic Communities (U.S. Dept. of Interior, USGS)	1999	Harry V. Leland	303-541-3021	http://wwwrvares.er.usgs.gov/nrp/proj.bib/leland.html
299) Microbial Transformation of Dissolved Organic Carbon in Aquatic Environments (U.S. Dept. of Interior, USGS)		Richard L. Smith	303-541-3032	http://wwwrvares.er.usgs.gov/nrp/proj.bib/smith.html
300) Interaction of Bacteria with Environmental Contaminants and Solid Surfaces in the Aquatic Environment (U.S. Dept. of Interior, USGS)		Ronald W. Harvey	303-541-3034	http://wwwrvares.er.usgs.gov/nrp/proj.bib/harvey.html

301) Microbial Biogeochemistry of Aquatic Environments (U.S. Dept. of Interior, USGS)	2000	Ronald S. Oremland	415-329-4482	http://wwwrvares.er.usgs.gov/nrp/proj.bib/oremland.html
302) Availability of Trace Elements in Sediments to Aquatic Organisms (U.S. Dept. of Interior, USGS)	April, 2000	Samuel N. Luoma	415-329-4481	http://wwwrvares.er.usgs.gov/nrp/proj.bib/luoma.html
303) Toxicity of lead-contaminated sediments to waterfowl (U.S. Dept. of Interior, USGS)	1999	Gary H. Heinz	Gary_Heinz@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/heinz1s.html
304) Development of Mixed Function Oxidase as a Bioindicator Model for Assessing Contaminant Exposure in Avian Embryos: Application for Field Bioassessments (U.S. Dept. of Interior, USGS	1998	Mark J. Melancon	Mark_Melancon@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/melan4s.html
305) Mercury in tree swallows and feathers of other species that line tree swallow nests at Acadia National Park, Maine (U.S. Dept. of Interior, USGS)	1998	Jerry R. Longcore	Jerry_Longcore@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/longco5s.html
306) Hazard Assessment of a Contaminated Wetland to Amphibians (U.S. Dept. of Interior, USGS)	1998	Donald Sparling	Don_Sparling@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/sparl3s.html
307) Bioavailability and potential effects of mercury and other selected trace metals on biota in Plow Shop and Grove Pond, Fort Devens, MA (U.S. Dept. of Interior, USGS)		Jerry R. Longcore	Jerry_Longcore@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/longco6s.html
308) Lead shot exposure to birds at a trap and skeet range at Patuxent Research Refuge (U.S. Dept. of Interior, USGS)	1998	Nimish B. Vyas	Dan_Twedt@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/vyas6s.html
309) Development of microsomal P450 as a bioindicator for environmental contaminant exposure (U.S. Dept. of Interior, USGS) m	1999	David J. Hoffman	David_Hoffman@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/melan3s.html
310) Managing coastal wetlands for increased biological diversity and carrying capacity (Ace Basin State Partnership - SC)(U.S. Dept. of Interior, USGS)	1998	Caldwell Hahn	Caldwell_Hahn@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/hahn2s.html

311) Contaminant impacts to early life stages of robust redhorse (Moxostoma robustum) in the Lower Oconee River, Georgia (U.S. Dept. of Interior, USGS)		Peter J. Lasier	Pete_Lasier@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/lasier2s.html
312) Species decline: Contaminants and other contributing factors (U.S. Dept. of Interior, USGS)	1998	Oliver H. Pattee	Hank_Pattee@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/pattee1s.html
313) Toxicity of common ions to the amphipod, Hyalellaazteca (U.S. Dept. of Interior, USGS)	1998	Peter J. Lasier	Pete_Lasier@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/lasier1s.html
314) Physiological and teratogenic effects of mercury on aquatic birds nesting along the mid-to lower Carson River and Vicinity, Nevada (U.S. Dept. of Interior, USGS)	1999	David J. Hoffman	David_Hoffman@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/hoffma4s.html
315) Evaluating the effects of environmental contaminants on populations, communities, and ecosystems (U.S. Dept. of Interior, USGS)	1999	Peter H. Albers	Pete_Albers@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/albers1s.html
316) Toxicity of biologically incorporated contaminants (U.S. Dept. of Interior, USGS)	1999	Gary H. Heinz	Gary_Heinz@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/heinz2s.html
317) Toxicity of lead-contaminated sediments to juvenile waterfowl, including estimation of sediment consumption by waterfowl (U.S. Dept. of Interior, USGS)	1999	Gary H. Heinz	Gary_Heinz@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/hoffma1s.html
318) Applying a Bioassessment and Monitoring Framework for Public Lands and Trust Resources Along the Atlantic Coast (U.S. Dept. of Interior, USGS)	1999	Barnett A. Rattner	Barnett_Rattner@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/rattnr2s.html
319) Role of sediment ingestion in the exposure of Chesapeake Bay wildlife to exposure of Chesapeake Bay wildlife (U.S. Dept. of Interior, USGS)	1999	Nelson W. Beyer	Nelson_Beyer@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/beyer1sa.html
320) Effects of organochlorine contaminants on reproductive success of black-crowned night-herons (Nycticorax nycticorax) nesting in Baltimore Harbor, Maryland (U.S. Dept. of Interior, USGS)	1999	Barnett A. Rattner	Barnett_Rattner@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/rattnr4s.html

321) Development of a general model for evaluating damage to a soil ecosystem from environmental contaminants and other stressors (U.S. Dept. of Interior, USGS)	19 98	Nelson W. Beyer	Nelson_ Beyer@ usgs.gov	http://www.pwrc .nbs.gov/researc h/sis98/beyer3s. html
322) Effects of Temephos and Methoprene on Macro-invertebrates and Amphibian Larvae in Freshwater Macrocosms (U.S. Dept. of Interior, USGS)	19 99	Peter T. Lowe	Peter_Lo we@usg s.gov	http://www.pwrc .nbs.gov/researc h/sis98/lowe2s.h tml
323) Technical Assistance in Biomarker Analyses (U.S. Dept. of Interior, USGS)	20 00	Mark J. Melancon	Mark_M elancon @usgs.g ov	http://www.pwrc .nbs.gov/researc h/sis98/melan2s. html

Topic Area 9: Technical Transfer (i.e., what information exchange is occurring)

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
324) Abandoned Mine Lands Initiative (AML) Water Resources: Part of the Department of the Interior Project Information Initiative--Pilot Study (U.S. Department of Interior, USGS)	2001	Wright, Winfield G.	970-245-5257	http://wwwop er.er.usgs.g ov/wais/WAI S.ntis.html

Topic Area 10: Other Documents/Projects

Question: Any thoughts on whether you'd find it useful to listing out all projects in the region, coupled with the regulatory status of each?

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**

325) Visual Resource Contrast Rating Handbook. BLM/H/8410/1. Washington, D.C.: U.S. Department of the Interior, BLM	1986	BLM		
326) Mineral Commodity Summaries 1999. Washington, D.C.	1999	USGS		
327) One Third of the Nation's Land. GPO, Washington D.C.: Government Printing Office	1970	U.S. Public Land Law Review Commiss ion.		
328) Competitiveness of the U.S. Minerals and Metals Industry. Washington, D.C.: National Academy Press.	1990.	NRC.		
329) Surface Mining of Non-Coal Minerals: A Study of Mineral Mining From the Perspective of the Surface Mining Control and Reclamation Act of 1977 (COSMAR Report). Washington, D.C.: National Academy Press.	1979	NRC (Nationa l Research Council).		
330) Land Ownership Information on the Acreage, Management, and Use of Federal and Other Lands	1996	GAO. (Govern ment Accounti ng Office)		Letter Report, 03/13/96, GAO/RCED-96-40
331) Land Areas of the National Forest System: As of September 1997. FS-383. Washington, D.C.: USDA, Forest Service.	1998.	U.S. Forest Service.		
332) Public Land Statistics--1998. Volume 183. BLM/BC/ST-99/001+1165. Washington, D.C.: U.S. Department of the Interior, BLM.	1999	BLM		
333) Surface Management Regulations for Locatable Mineral Operations (43 CFR 3809): Draft Environmental Impact Statement. Washington, D.C.: U.S. Department of the Interior, BLM.	1999	BLM		
334) Public Land Statistics--. BLM/SC/PT-92/011+1165. Volume 176. Washington, D.C.: U.S. Department of the Interior, BLM.	1991	BLM		
335) National Environmental Policy Act Handbook. BLM/H/1790/1. Washington, D.C.: U.S. Department of the Interior, BLM.	1988.	BLM		

336) Public Land Statistics--1993. Volume 178. BLM/SC/ST-94/001+1165. Washington, D.C.: U.S. Department of the Interior, BLM.	1994.	BLM		
337) Mining Technology Vision Panel. Unpublished report prepared for U.S. Department of Energy and the National Partnerships for Mining and Minerals Technology. Salt Lake City, Utah.				
337.1) Arizona Mining summit Guide to Permitting Mining Operations. This guide lists all necessary permtis to operate a mine in Arizona on either private state or federal lands.	March 2000	Ralph Costa; BLM, AZSO	(602) 417-9349	BLM/AZ/GI-99/010
337.2) Final Report - South Pass Abandoned Mine Land (AML) Pilot Study Project, Southern Fremont County, Wyoming: unpublished report, BLM Wyoming State Office	March 1998	Ed Heffern, Wyomin g SO	(307) 775-6259	unpublished
337.3) Preliminary Assessment Data Requirements for Federal Facility Docket Sites, Site Investigation for Red Devil Mine Site (BLM, Alaska)	1999	Mike Alcorn, BLM Anchora ge FO	(907) 267-1442	
337.4) Preliminary Assessment Data Requirements for Federal Facility Docket Sites, Red Top Retort Site: BLM	1998	Mike Alcorn, BLM Anchora ge FO	(907) 267-1442	

Topic Area 11: Modeling and predictive tools

Abstract of Project/Product/Activity; Any Time/Political Constraints?	**Schedule** (month/yr complete)	**Contact Information**		
		Name, Region/ Office/ Lab	**phone/ email**	**Publication number/ web address**
338) Chemical Models of Natural Systems (U.S. Dept. of Interior, USGS)		Donald C. Thorsten son	303-236-6229	http://wwwrvares.er.usgs.gov/nrp/proj.bib/thorstenson.html
339) Reaction-Transport Modeling in Ground-Water Systems (U.S. Dept. of Interior,		David L. Parkhurs t	303-236-5098	USGS)http://wwwrvares.er.usgs.gov/nrp/proj.bib/parkhurst.html

340) Digital Modeling of Transport in the Saturated Zone (U.S. Dept. of Interior, USGS)		Leonard F. Konikow	703-648-5878	http://wwwrvares.er.usgs.gov/nrp/proj.bib/konikow.html
341) Development of Mixed Function Oxidase as a Bioindicator Model for Assessing Contaminant Exposure in Avian Embryos: Application for Field Bioassessments (U.S. Dept. of Interior, USGS)	1998	Mark J. Melancon	Mark_Melancon@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/melan4s.html
342) Development of a general model for evaluating damage to a soil ecosystem from environmental contaminants and other stressors (U.S. Dept. of Interior, USGS)	1998	Nelson W. Beyer	Nelson_Beyer@usgs.gov	http://www.pwrc.nbs.gov/research/sis98/beyer3s.html
343) Simulated Effects of Proposed Ground-Water Pumping in 17 Basins of East-Central and Southern Nevada.(USGS)	1995	Schaefer, D. H., and J. R. Harrill.		USGS Water Resources Investigations Report 95-4173.
344) Studies of Suction Dredge Gold-Placer Mining Operations Along the Fortymile River, Eastern Alaska, USGS	1997	Wanty, R .B., B. Wang, and J. Vohden.		U.S. Geological Survey Fact Sheet FS-154-97.

V. Other References:

A) Web Pages:

http://www.blm.gov/narsc/aml/

http://www.epa.gov/ceisweb1/ceishome/atlas/ohiowaters/uses/mining_and_america.htm

http://www.epa.gov/owmitnet/permits/hrmining/

http://www.epa.gov/epaoswer/other/mining.htm

http://www.epa.gov/epaoswer/non-hw/tribal/thirds/remine.htm

http://www.ec.gc.ca/envhome.html

http://www.nrcan.gc.ca/mets/mend/default_e.htm (this is the key acid rock drainage site)

www.enviromine.com (this has links to lots of sites)

http://www.infomine.com/technology/enviromine/ard/welcome.htm (good overall site)

http://www.cnie.org/nle/crsmine.html (Congressional Research Service Reports - CRS reports summarize particular environmental issues for members of Congress)

http://www.epa.gov/ORD/NRMRL/std/mtb/mwtphome.htm (EPA/ORD's Butte Montana Research program and research abstracts)

http://www.epa.gov/ttbnrmrl/pitlakes.htm Workshop on the Characterization, Modeling, Remediation, and Monitoring of Mining-Impacted Pit Lakes, USEPA, April 4 - 6, 2000 Sands Regency Casino Hotel, Downtown Reno, Nevada, For more information: (703) 645-6945

http://books.nap.edu/html/hardrock_fed_lands/index.html (Hardrock Mining on Federal Lands)
This Study was conducted by the Committee on Hardrock Mining on Federal Lands, Committee on Earth Resources, Board on Earth Sciences and Resources, Commission on Geosciences, Environment, and Resources, National Research Council, and published by the NATIONAL ACADEMY PRESS, Washington, D.C. 1999. Committee members are drawn from the councils of the National Academy of Sciences, the National Academy of Engineering, and the Institute of Medicine. This study was supported by the Bureau of Land Management, Department of the Interior.

Office of Surface Mining. U.S. Department of the Interior (http://www.osmre.gov/osm.htm)

U.S. Bureau of Reclamation, includes a list of laws about minerals and mining (http://www.usbr.gov/main/ and http://www.usbr.gov/laws/mines.html

National Mine Land Reclamation Center, http://www.nrcce.wvu.edu/
U.S. Geological Survey, Mineral Resources Program, http://minerals.usgs.gov/ (publications search at http://usgs-georef.cos.com/)

B) Other Non-Federal Agency References

[note: some references are repeated in multiple topic areas if it seemed appropriate to do so]

Topic Areas:

1) Characterization/monitoring

Gabriel, I. E., and D. T. Patten. 1994. Distribution of copper smelter emissions in southeastern Arizona using honey mesquite as bioindicator. Water, Air, and Soil Pollution 72:67-87.

Gabriel, I. E., and D. T. Patten. 1995a. Changes in the inorganic element concentration spectrum of mesquite foliage during operational and non-operational periods of a copper smelter. Water, Air, and Soil Pollution 81:207-217.

Gabriel, I. E., and D. T. Patten 1995b. Establishing a standard Sonoran reference plant and its application in monitoring industrial and urban pollution throughout the Sonoran Desert. Environmental Monitoring and Assessment 36:27-43.

Price J.G., Shevenell, L., Henry, C.D., Rigby, J.G., Christensen, L., Lechler, P.J., Desilets, M., Fields, R., Driesner, D., Durbin, B., and Lombardo, W., 1995. Water quality at inactive and abandoned mines in Nevada: Nevada Bureau of Mines and Geology Open File Reports 95-4, 72.

Runnells, D. D., M. J. Shields, and R. L. Jones. 1997. Methodology for adequacy of sampling of mill tailings and mine waste rock. In Tailings and Mine Waste, A. A. Balkema, ed. Ft. Collins, CO: Rotterdam and Brookfield.

Schafer, W. M. 1993. Design of geochemical sampling programs. Presentation at Mine Operation and Closure

Short Course. Helena, MT., April 27-29, 1993.

Tempel, R. N., L. A. Shevenell, P. Lechler, and J. Price. In preparation. Geochemical modeling approach to predicting arsenic concentrations in a mine pit lake.

2) Remote Sensing

3) Fate/transport

Blanchard, C. L., and M. Stromberg. 1987. Acidic precipitation in southeastern Arizona: Sulfate, nitrate and trace-metal deposition. Atmospheric Environment 21:2375-2381.

Oppenheimer, M., and C. B. Epstein. 1985. Acid deposition, smelter emissions and the linearity issue in the western United States. Science 229:859.

Environmental Geochemistry of Sulfide Oxidation (ed. C. Alpers and D. Blowes) ACS Symposium Series 550 1992.

4) Control of releases from mining sites

AGI Mining Series #3; Metal Mining in the Environment

Price, W.A. and Errington, J.C., 1998. Guidelines for Metal Leaching and Acid Rock Drainage at Minesites in British Columbia. Minstry of Energy and Mines, August.

Price, W.A. 1997. Draft Guidelines and Recommended Methods for the Predicition of Metal Leaching and Acid Rock Drainage at Minesites in British columbia. Ministry of Employment and Investment. Energy and Minerals Division.

Minnesota DNR (1994) Mine Waste Drainage Quality Prediction (K. Lapakko)

B.C. Ministry of Energy and Mines (1997) Draft Guidelines for Predicting of Metal Leaching and ARD at Minesites in British Columbia (W. Price)

5) Risk assessment

Blanchard, C. L., and M. Stromberg. 1987. Acidic precipitation in southeastern Arizona: Sulfate, nitrate and trace-metal deposition. Atmospheric Environment 21:2375-2381.

Oppenheimer, M., and C. B. Epstein. 1985. Acid deposition, smelter emissions and the linearity issue in the western United States. Science 229:859.

6) Remediation and treatment

Shokes, T. E., and G. Moller. 1999. Removal of dissolved heavy metals from acid rock drainage using iron metal. Environmental Science and Technology 33:282-287.

Simberloff, D., and L. G. Abele. 1982. Refuge design and island biogeographic theory: Effects of fragmentation. American Naturalist 120:41-50.

7) Environmental effects (i.e., physical/chemical effects to the environment)

Buck, B. W. (convener) (J.B.R. Consultants Group, Salt Lake City, UT, United States), Environmental and support-system problems for industrial-mineral mining, USGS ref # 1993-004320.

Matthews, Robert A. (convener), The environmental impacts of mining and their mitigation, USGS ref # 1991-004841.

Eary, L. E. In press. Geochemical and equilibrium trends in mine pit lakes. Applied Geochemistry.

Hagler Bailly Consulting, Inc. 1996. Supplemental Injury Assessment Report: Clark Fork River NPL Sites Natural Resource Damage Assessment--Lethal Injuries to Snow Geese, Butte, Montana. Prepared for State of Montana Natural Resource Damage Litigation Program, Helena.

8) Ecological (i.e., biological/ecosystem effects to the environment)

Azenha, M., M. T. Vasconcelos, and J. P. S. Cabral. 1995. Organic ligands reduce copper toxicity in Pseudomonas syringae. Environmental Toxicology and Chemistry 14:369-373.

Beltman, D. J., W. H. Clements, J. Lipton, and D. Cacela. 1999. Benthic invertebrate metals exposure, accumulation, and community-level impacts downstream of a hard-rock mine site. Environmental Toxicology and Chemistry 18:299-307.

Bolis, C. L., A. Cambria, and M. Fama. 1984. Effects of acid stress on fish gills. Pp. 120-122 in Toxins, Drugs, and Pollutants in Marine Animals, C. L. Bolis, A. Cambria, and M. Fama, eds. Berlin: Springer Verlag.

Borgmann, U., and K. M. Ralph. 1984. Copper complexation and toxicity to freshwater zooplankton. Archives of Environmental Contamination and Toxicology 13:403-409.

Brattstrom, B. H., and M. C. Bondello. 1983. Effects of off-road vehicle noise on desert vertebrates. Pp. 167-206 in Environmental Effects of Off-road Vehicles: Impacts and Management in Arid Regions, R. H. Webb and H. G. Wilshire, eds. New York: Springer Verlag.

Brown, V. M., T. L. Shaw, and D. G. Shurben. 1974. Aspects of water quality and the toxicity of copper to rainbow trout. Water Research 8:797-803.

Chakoumakos, C., R. C. Russo, and R. V. Thurston 1979. Toxicity of copper to cutthroat trout (Salmo clarki) under different conditions of alkalinity, pH, and hardness. Environmental Science and Technology 13:213-219.

Clements, W. H. 1994. Benthic invertebrate community responses to heavy metals in the upper Arkansas River Basin, Colorado. Journal of the North American Benthological Society 13:30-44.

Clements, W. H., D. S. Cherry, and J. Cairns, Jr. 1988. The impact of heavy metals on macroinvertebrate communities: A comparison of observational and experimental results. Canadian Journal of Fisheries and Aquatic Sciences 45:2017-2025.

DeLonay, A. J., E. E. Little, J. Lipton, D. Woodward, and J. Hansen. 1995. Avoidance response as evidence of injury: The use of behavioral testing in support of natural resource damage assessments. In Environmental Toxicology and Risk Assessment, T. W. LaPoint, F. T. Price, and E. E. Little, eds. Philadelphia: American Society for Testing and Materials.

Erickson, R. J., D. A. Benoit, V. R. Mattson, H. P. Nelson, and E. N. Leonard, 1996. The effects of water chemistry on the toxicity of copper to fathead minnows. Environmental Toxicology and Chemistry 15:181-193.

Gabriel, I. E., and D. T. Patten. 1994. Distribution of copper smelter emissions in southeastern Arizona using honey mesquite as bioindicator. Water, Air, and Soil Pollution 72:67-87.

Gabriel, I. E., and D. T. Patten. 1995a. Changes in the inorganic element concentration spectrum of mesquite foliage during operational and non-operational periods of a copper smelter. Water, Air, and Soil Pollution 81:207-217.

Gabriel, I. E., and D. T. Patten 1995b. Establishing a standard Sonoran reference plant and its application in monitoring industrial and urban pollution throughout the Sonoran Desert. Environmental Monitoring and Assessment 36:27-43.

Galbraith, H., K. LeJeune, and J. Lipton. 1996. Metal and arsenic impacts to soils, vegetation communities, and wildlife habitat in southwest Montana uplands contaminated by smelter emissions: I. Field evaluation. Environmental Toxicology and Chemistry 14:1895-1903.

Howarth, R. S., and J. B. Sprague. 1978. Copper lethality to rainbow trout in waters of various hardness and pH. Water Research 12:455-462.

Kapustka, L., J. Lipton, H. Galbraith, D. Cacela, and K. LeJeune. 1996. Metal and arsenic impacts to soils, vegetation communities, and wildlife habitat in southwest Montana uplands contaminated by smelter emissions: II. Laboratory phytotoxicity studies. Environmental Toxicology and Chemistry 14:1905-1912.

Kiffney, P. M. and W. H. Clements. 1993. Bioaccumulation of heavy metals by benthic invertebrates at the Arkansas River, Colorado. Environmental Toxicology and Chemistry 12:1507-1517.

Kiffney, P. M., and W. H. Clements. 1996a. Size-dependent response of macroinvertebrates to metals in experimental streams. Environmental Toxicology and Chemistry 15:1352-1356.

Kiffney, P. M., and W. H. Clements. 1996b Effects of heavy metals on stream macroinvertebrate assemblages from different elevations. Ecological Applications 6:472-481.

Kummerow, M. 1992. Weeds in wilderness: A threat to biodiversity. Western Wildlands 18:12-17.

Lauren, D. J., and D. G. MacDonald, 1986. Influence of water hardness, pH and alkalinity on the mechanisms of copper toxicity in juvenile rainbow trout, Salmo gairdneri. Canadian Journal of Fisheries and Aquatic Sciences 43:1488-1496.

LeJeune, K., H. Galbraith, J. Lipton, and L. A. Kapustka. 1996. Effects of metals and arsenic on riparian soils, vegetation communities, and wildlife habitat in southwest Montana. Ecotoxicology 5:297-312.

MacRae, R. K., A. S. Maest, and J. S. Meyer. In press. Selection of an organic-acid analogue of dissolved organic matter for use in toxicity testing. Canadian Journal of Fisheries and Aquatic Sciences.

Marr, J., H. L. Bergman, J. Lipton, and C. Hogstrand. 1995a. Differences in relative sensitivity of naive and metals-acclimated brown and rainbow trout exposed to metals representative of the Clark Fork River, Montana Canadian Journal of Fisheries and Aquatic Sciences 52:2016-2030.

Marr, J., H. L. Bergman, M. Parker, W. Erickson, D. Cacela, J. Lipton, and G. R. Phillips. 1995b. Relative sensitivity of brown and rainbow trout to pulsed exposures of an acutely lethal mixture of metals typical of the Clark Fork River, Montana. Canadian Journal of Fisheries and Aquatic Sciences 52:2005-2015.

Marr, J. C. A., J. Lipton, D. Cacela, J. A. Hansen, H. L. Bergman, J. S. Meyer, and C. Hogstrand. 1996.

Relationship between copper exposure duration, tissue copper concentration, and rainbow trout growth. Aquatic Toxicology 36:17-30.

Marr, J. C., J. Lipton, D. Cacela, J. A. Hansen, J. S. Meyer, and H. L. Bergman. 1999. Bioavailability and acute toxicity of copper to rainbow trout (Oncorhynchus mykiss) in the presence of organic acids simulating natural dissolved organic carbon. Canadian Journal of Fischeries and Aquatic Sciences 56(8):1471-1483.

Nelson, S. M., and R. A. Roline. 1993. Selection of the mayfly Rhithrogena hageni as an indicator of metal pollution in the Upper Arkansas River. Journal of Freshwater Ecology 8:111-119.

Nelson, S. M., and R. A. Roline. 1996. Recovery of a stream macroinvertebrate community from mine drainage disturbance. Hydrobiologia 339:73-84.

Playle, R. C., D. G., Dixon, and K. Burnison. 1993. Copper and cadmium binding to fish gills: Modification by dissolved organic carbon and synthetic ligands. Canadian Journal of Fisheries and Aquatic Sciences 50:2667-2677.

Scott, M. L., P. B. Shafroth, and G. T. Auble. In press. Responses of riparian cottonwoods to alluvial water declines. Environmental Management.

Sorenson, E. M. 1991. Metal Poisoning in Fish. Boca Raton, Fla.: CRC Press, Inc.

Stromberg, J. C., and D. T. Patten. 1992. Response of Salix lasiolepis to augmented stream flows in the upper Owens River. Madrono 39:224-235.

Stromberg(a), J. C., J. A. Tress, S. D. Wilkins, and S. D. Clark. 1992. Response of velvet mesquite to ground water decline. Journal of Arid Environments 23:45-58.

Stromberg(b), J. C., R. Tiller, and B. Richter. 1996. Effects of groundwater decline on riparian vegetation of semiarid regions: The San Pedro, Arizona. Ecological Applications 6:113-131.

Sullivan, M. E. 1991. Heavy Metal Concentration in Riparian Vegetation Exposed to Wastewater Effluent. Masters thesis. Arizona State University, Tempe.

Wood, C. W., and T. H. Nash III. 1976. Copper smelter effluent effects on Sonoran Desert vegetation. Ecology 57:1311-1316.

9) Technical Transfer (i.e., what information exchange is occurring)

American Geological Institute. 1997. Dictionary of Mining, Mineral, and Related Terms, 2nd Edition. Ventura Publishing 3.0

10) Other Documents/Projects

Metal Mining in the Environment; AGI Mining Series #3

Anderson, J. A. 1982. Gold--its history and role in the U.S. economy and the U.S. exploration program of Homestake Mining Company. Mining Congress Journal 68(1):51-58.

Barringer, S. 1999. Mining Regulatory Programs in the Western United States: A Survey of State Laws and Regulations. Unpublished report prepared for the Precious Metals Producers; Singer, Brown, & Barringer, Nevada.
Beebe, R. R. 1995.

Coope, J. A. 1991. Carlin Trend exploration history: Discovery of the Carlin deposit. Nevada Bureau of Mines and Geology Special Publication 13.

Dobra, J. L. 1997. The U. S. Gold Industry 1996. Special Publication 21. Reno: Nevada Bureau of Mines and Geology.

Dobra, J. L. 1999. The U. S. Gold Industry 1998, Special Publication 25. Reno: Nevada Bureau of Mines and Geology.

Gentry, D. W. 1998. Constrained prospects of mining's future. Mining Engineering: 85-94.

Gough, L., W. Day, J. Crick, B. Gamble, and M. Henning. 1997. Placer-gold Mining in Alaska--Cooperative Studies on the Effect of Suction Dredge Operations on the Fortymile River. U.S. Geological Survey Fact Sheet FS-155-97.

Guilbert and Park, 1986. The Geology of Ore Deposits. W.H. Freeman and Company. New York. 985 pp.

Interstate Mining Compact Commission. 1997. Noncoal Mineral Resource Report. Herndon, Virginia.

Leshy, J. D. 1987. The Mining Law: A Study in Perpetual Motion. Washington, D.C.: Resources for the Future, Inc.

McElfish, J. M., T. Bernstein, S. P. Bass, and E. Sheldon. 1996. Hard Rock Mining: State Approaches to Environmental Protection. Washington, D.C.: Environmental Law Institute.

Nelson, R. L., M. L. McHenry, and W. W. Platts. 1991. Mining. American Fisheries Society Special Publication 19:425-457.

Northwest Mining Association. 1997. Permitting Directory for Hard Rock Mineral Exploration. Spokane, Washington.

Patten, D. T., J. C. Stromberg, and M. R. Sommerfeld. 1994. Water and Riparian Resources of the Santa Cruz River Basin: Best Management Practices for Water and Resource Quality. Final Report to Southwest Center for Environmental Research and Policy. Salt Lake City: University of Utah.

Roscoe, W. E. 1971. Probability of an exploration discovery in Canada. Canadian Mining and Metallurgical Bulletin, Vol. 64, (707): 134-137.

Round Mountain Gold Corporation. 1994. Round Mountain Gold, An introduction for visitors. Unpublished company report.

Swenson, R.W. 1968. Legal aspects of mineral resources exploitation. In History of Public Land Law Development, P.W. Gates, ed. Washington, D.C.: Government Printing Office.

Tingley, J. V., and B. R. Berger. 1985. Lode Gold Deposits of Round Mountain, Nevada. Nevada Bureau of Mines and Geology Bulletin 100.

Tingley, J. V., and H. F. Bonham, Jr. 1998. Major precious-metal deposits. In The Nevada Mineral Industry 1997, J. G. Price, J. V. Tingley, D. D. LaPointe, H. F. Bonham, Jr., S. B. Castor, and D. A. Davis, eds. Nevada Bureau of Mines and Geology Special Publication MI-1997.

University of California. 1988. Mining Waste Study Final Report. Prepared by the Mining Waste Study Team of the University of Calfornia at Berkeley, July. 416 pp.